

Fishery Data Series No. 13-34

Sonar Enumeration of Pacific Salmon Escapement into the Nushagak River, 2009

by

Gregory B. Buck

July 2013

Alaska Department of Fish and Game

Divisions of Sport Fish and Commercial Fisheries



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Weights and measures (metric)		General		Mathematics, statistics	
centimeter	cm	Alaska Administrative	AAC	<i>all standard mathematical signs, symbols and abbreviations</i>	
deciliter	dL	Code		alternate hypothesis	H _A
gram	g	all commonly accepted	e.g., Mr., Mrs., AM, PM, etc.	base of natural logarithm	e
hectare	ha	abbreviations		catch per unit effort	CPUE
kilogram	kg			coefficient of variation	CV
kilometer	km	all commonly accepted	e.g., Dr., Ph.D., R.N., etc.	common test statistics	(F, t, χ^2 , etc.)
liter	L	professional titles		confidence interval	CI
meter	m		@	correlation coefficient	R
milliliter	mL	at		(multiple)	
millimeter	mm	compass directions:		correlation coefficient	
		east	E	(simple)	r
		north	N	covariance	cov
		south	S	degree (angular)	°
		west	W	degrees of freedom	df
		copyright	©	expected value	E
		corporate suffixes:		greater than	>
		Company	Co.	greater than or equal to	≥
		Corporation	Corp.	harvest per unit effort	HPUE
		Incorporated	Inc.	less than	<
		Limited	Ltd.	less than or equal to	≤
		District of Columbia	D.C.	logarithm (natural)	ln
		et alii (and others)	et al.	logarithm (base 10)	log
		et cetera (and so forth)	etc.	logarithm (specify base)	log ₂ , etc.
		exempli gratia		minute (angular)	'
		(for example)	e.g.	not significant	NS
		Federal Information		null hypothesis	H ₀
		Code	FIC	percent	%
		id est (that is)	i.e.	probability	P
		latitude or longitude	lat. or long.	probability of a type I error	
		monetary symbols		(rejection of the null hypothesis when true)	α
		(U.S.)	\$, ¢	probability of a type II error	
		months (tables and		(acceptance of the null hypothesis when false)	β
		figures): first three		second (angular)	"
		letters	Jan,...,Dec	standard deviation	SD
				standard error	SE
		registered trademark	®	variance	
	AC	trademark	™	population	Var
	A	United States		sample	var
	cal	(adjective)	U.S.		
	DC	United States of	USA		
	Hz	America (noun)	United States		
	hp	U.S.C.	Code		
	pH	U.S. state	use two-letter		
			abbreviations		
			(e.g., AK, WA)		
volts	V				
watts	W				

FISHERY DATA SERIES NO. 13-34

**SONAR ENUMERATION OF PACIFIC SALMON ESCAPEMENT INTO
THE NUSHAGAK RIVER, 2009**

by

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ABSTRACT

Hydroacoustic techniques were used to develop escapement estimates of sockeye *Oncorhynchus nerka*, Chinook *O. tshawytscha*, and chum *O. keta* salmon for the Nushagak River in Bristol Bay, Alaska from 6 June through 18 July 2009. A standard range dual frequency identification sonar (DIDSON) was used to estimate salmon escapement on the left (south) bank, and a long range DIDSON was used to estimate salmon escapement on the right (north) bank. Estimates of species composition, age, sex, and size composition were derived from samples obtained with drift gillnets and beach seine at the sonar site. Final escapement estimates through 18 July were 484,149 sockeye, 81,480 Chinook, and 438,481 chum salmon. The timing of the sockeye and chum escapement was 1 day earlier than the 2000–2008 average and 2 days earlier for Chinook salmon. The major age classes estimated for sockeye salmon were age 1.3 (67.2%), age 1.2 (15.6%), and age 1.4 (12.2%). The major age classes for Chinook salmon were age 1.3 (33.9%), age 1.4 (36.1%), and age 1.2 (29.6%).

Key words: Pacific salmon *Oncorhynchus*, sockeye salmon *O. nerka*, Chinook salmon *O. tshawytscha*, chum salmon *O. keta*, DIDSON, sonar, Nushagak River, Bristol Bay, escapement, estimation, fisheries management

INTRODUCTION

The purpose of this study was to estimate escapement of 3 species of Pacific salmon *Oncorhynchus* spp. to the Nushagak River in Bristol Bay, Alaska: sockeye (*O. nerka*), Chinook (*O. tshawytscha*), and chum (*O. keta*). Escapement estimates are used to assess daily run strength and provide escapement goal information that is critical to the management of commercial salmon fishing in Nushagak District.

Nushagak River escapements were initially estimated using aerial surveys in 1956 (Nelson 1987). In 1979, the Alaska Department of Fish and Game (ADF&G) examined the feasibility of using side-scanning sonar (hydroacoustic) equipment on the Nushagak River near the village of Portage Creek. This system evolved into the Bendix sonar system which became the salmon enumeration tool used for this task over the next several decades (McBride 1981). While aerial surveys continued to be flown during the early years of sonar enumeration, eventually, the Nushagak River sonar project evolved to the point that it became the sole basis for salmon escapement information. An independent estimate of sockeye passage was made in 2006 which yielded an estimated sockeye passage at the village of Ekwok (approximately 40 mi upriver from the sonar site), of 558,852 sockeye, which compares favorably with the sonar estimate of 548,410 sockeye across a very similar time frame (Daigneault et al. 2007). Around the turn of the century, concerns over the increasingly difficult upkeep of this aging system led ADF&G to consider more modern hydroacoustic technologies.

Robertson (1984) used scale pattern analysis to determine that the majority (93%) of sockeye salmon migrating past Portage Creek were native to the watershed while Daigneault et al. (2007) identified the Nuyakuk, King Salmon and Koktuli rivers as major spawning destinations of sockeye salmon in this watershed. In addition, recent genetics results indicate at least 90% of sockeye salmon migrating past the sonar site were from the Nushagak River watershed (Dann et al. 2009). It appears therefore, that very few fish encountered at the project site are strays from other rivers that might back out of the river or migrate back downstream at a later date.

In 2002, ADF&G tested the feasibility of a standard range (SR) dual frequency identification sonar¹ (DIDSON) to evaluate its capability as a viable replacement for the existing Bendix counters (Maxwell and Gove 2004; Burwen et al. 2007). Originally developed by the University

¹ Product names used in this report are included for scientific completeness, but do not constitute a product endorsement.

of Washington, Applied Physics Laboratory to allow divers to identify mines in turbid waters, the DIDSON creates video-like images (Belcher et al. 2001, 2002). The DIDSON's small pulse widths, high frequency, and extremely small multiple beams create identifiable fish targets even when more than 1 fish is in the beam. The higher than standard frequency waves reflect off the entire surface of the fish as opposed to only the acoustically "hard" swim bladder. This creates an actual image of the fish that can be counted on a video feed whereas the Bendix sonar simply uses the echo return strength to estimate how many fish are in the beam.

During the 2003 and 2004 field seasons, the SR DIDSON was deployed on the left (south) bank (facing downriver) of the Nushagak River in a comparative study alongside the Bendix (Maxwell et al. 2011). In addition to its ability to produce high resolution images, the DIDSON has a unique acoustic lens system that allows the beam to be focused at different ranges by altering the frequency. The SR DIDSON was operated at 2 frequencies, 1.80 MHz with range settings to 10 m and 1.10 MHz with coverage out to 36 m, providing approximately the same coverage as the Bendix sonar counter.

In 2004 and 2005, a newly developed long range (LR) DIDSON was operated upstream of the Bendix counter on the right (north) bank (facing downriver) alongside the Bendix (Brazil 2008; Maxwell et al. 2011). The LR DIDSON operates at 2 frequencies: 1.20 MHz which allows identification of targets out to 20 m and 0.70 MHz which allows identification of targets out to 60 m. This provided greater river coverage than the Bendix. The escapement estimates used for management on the left bank have been made using the SR DIDSON beginning in 2005 and using a LR DIDSON on the right bank beginning in 2006. Periodically, Bendix sonar equipment has been operated alongside these DIDSON units for the purposes of gathering comparison data.

In addition to estimating the total number of salmon migrating upstream, an accurate estimate of the species composition, age composition, and size/sex for each species is needed to manage towards species-specific management plans and forecast future returns. Species are apportioned by drifting a suite of various sized gillnets in the ensonified area of the river and estimating catch per unit of effort (CPUE) for each species. This basic direct sampling approach has been modified numerous times over the years. Brannian et al. (1995) evaluated escapement sampling and associated species apportionment methods used on Nushagak River during 1991 and compared them with methods used on the Lower Yukon River. Based on their review, new methods of estimating Nushagak River salmon passage by species were incorporated in 1992 (Miller et al. 1994a). The method used from 1992 through 2001 created a situation where preliminary species composition estimates were only made after 100 salmon were caught. After 100 salmon were caught, the preliminary species composition estimates were retroactively applied to the escapement count during the season. This created a situation where numerous inseason changes were made to the escapement estimates during the season. This delay caused management concern about the ability to detect rapid shifts in species composition in a manner timely enough to allow management to react. An internal simulation analysis determined in 2002 that using a sample size of 5 fish to estimate species composition during a report period had minimal effects on the daily estimates, was less biased, and more accurate (McKinley 2003). This method has the advantage of providing almost daily estimates of escapement without retroactive changes. One downside to the reduction in sample size from 100 fish to 5 fish was the increase in variance estimates for the species composition estimates. Scale and size/sex sampling is accomplished concurrently with species apportionment sampling.

OBJECTIVES

The project objectives in 2009 were to:

1. Estimate the number of adult sockeye, Chinook, and chum salmon in the Nushagak River from early June through late July such that the escapement estimates were within +/- 10% of the true value 90% of the time. This was accomplished by combining the estimate of the number of salmon-sized hydroacoustic targets passing through the sonar beam(s) with the species composition estimate derived from test fishing with drift gillnets.
2. Estimate the proportion of each of the major sockeye salmon age classes (1.2, 2.2, 1.3, 2.3, 1.4) in the Nushagak River to within 5% of the true proportion 90% of the time;
3. Estimate the sex compositions of the escapements of sockeye, Chinook, and chum salmon in the Nushagak River.
4. Estimate the mean length by age of sockeye, Chinook, and chum salmon in the Nushagak River escapement.

In addition to these objectives, daily weather observations (temperature, precipitation, water clarity, etc.) were recorded at the sonar site.

METHODS

STUDY SITE

The Nushagak River is located in Southwestern Alaska and flows approximately 390 km from its headwaters to Bristol Bay (Figure 1). The Nushagak drainage has 2 main tributaries: the Nuyakuk River, draining Tikchik Lakes, which enter from the west, and the Mulchatna River, which flows into the Nushagak from the east. These rivers support large runs of 5 species of Pacific salmon (Table 1) as well as several resident species that are harvested in commercial, sport, and subsistence fisheries.

The project site was located on the lower Nushagak River, approximately 40 km upstream from the terminus of the Nushagak commercial fishing district and 4 km downstream from the village of Portage Creek (Figure 1). At the project site, the Nushagak River is contained to one 300 m wide channel, with the exception of 1 very small slough behind the camp. The site is within the range of tidal influence. While high tide causes a reduction in current there is rarely a reversal of flow and it appears that fish are actively migrating past the project site as few fish are observed milling in the area. Robertson (1984) used scale pattern analysis to determine that the majority (93%) of sockeye salmon migrating past Portage Creek were native to the watershed while Daigneault et al. (2007) identified the Nuyakuk, King Salmon, and Koktuli Rivers as major spawning destinations of sockeye salmon in this watershed. In addition, recent genetics results indicate at least 90% of sockeye salmon migrating past the sonar site were from the Nushagak River watershed (Dann et al. 2009). It appears therefore, that very few fish encountered at the project site are strays from other rivers that might back out of the river or migrate back downstream at a later date.

PROJECT DATES

Project operation dates have varied over the years. In 2007, counts terminated on 19 July. Historically (since 1990) more than 95% of the cumulative sockeye salmon passage has occurred

by this date. Through 2004, with the exception of 1992 and 2003, operational dates extended to at least 16 August each season to include the majority of the run for all salmon species. In 1992, the project terminated on 22 July due to budget shortfalls. Similarly, in 2003 the project terminated on 20 July, a date that historically includes about 98% of the cumulative sockeye salmon passage. In 2004, the Bristol Bay Science & Research Institute provided funds that allowed the project to extend to 18 August which provided a more accurate estimate of the later running coho salmon. Due to continuing budget constraints, it is not anticipated that project operation dates will extend past 20 July in future years.

HYDROACOUSTIC ESTIMATES

SR DIDSON: Left Bank

The left bank SR DIDSON was deployed with a Hydroacoustics Technology Inc. automated, single-axis rotator, and a BioSonics internal attitude sensor that provided heading, pitch, and roll data in 1 s intervals. The DIDSON was affixed to the rotator that was mounted on the cross piece of an aluminum “H-shaped” mount. This assembly was placed in the river such that the DIDSON transducer was entirely submerged at low water with approximately 0.19 m (7.5 in) clearance between the bottom of the lens and river bottom to allow for pitch adjustment. Orientation for the best image was obtained by adjusting the heading manually while the mounting assembly was leveled with a bubble level. Target testing was conducted with a tungsten steel ball passed through the sonar beam vertically and horizontally to identify the effective detection envelope. Adjustments were made autonomously to pitch, or manually to heading, to maximize the detection envelope.

Once the transducer was properly emplaced, a picket weir was constructed from the shore to just beyond the transducer on both riverbanks using pipe, aluminum angle, and plastic fencing. This prevented fish from passing behind the transducers or within approximately 1 m of the transducer face, a distance at which the system may not detect fish.

Data were streamed via wireless connection from the left bank to the sonar operations tent on the right bank where it was handled on a dedicated laptop. Sonar files were recorded to an external hard drive. Left bank DIDSON counts were performed for 10 min each hour in 2 strata: (1) inshore, 1–10 m, and (2) offshore, 10–30 m.

LR DIDSON: Right Bank

Assembly, deployment, and testing of the LR DIDSON occurred in a manner similar to that used on the left bank. The LR DIDSON was physically cabled to a dedicated laptop in the operations tent. Sonar files were recorded to an external hard drive. Right bank DIDSON counts were performed for 10 min each hour in 2 strata: (1) inshore, 1–10 m, and (2) offshore, 10–50 m.

DIDSON: Counting Fish on DIDSON (Playback of files)

The DIDSON software program was used to programmatically capture one 10 min file using inshore settings and one 10 min file using offshore settings on each bank each hour. Equipment settings and timing of file record events were controlled using software specifically designed for DIDSON operations. Frame rates were set as high as the system would allow without dropping significant numbers of frames during recording sessions (generally between 3 and 8 frames per second). Recordings were made using an intensity setting of 90, and threshold setting of 10, with auto-frequency, smoothing, and default focus enabled.

Playback of the hourly 10-min files for inshore and offshore strata was completed soon after they were recorded throughout the day, or early morning in the case of files recorded overnight. Missing counts were interpolated by averaging counts 2 hr before and 2 hr after the missing counts. Entering the 10-min counts provided an accurate cross check of each day's hourly counts by stratum. Backup files were maintained on CDs.

SPECIES COMPOSITION SAMPLING

Daily sonar counts were apportioned among salmon species based on test fish catches collected with 18.3 m (10 fathom) drift gillnets with mesh sizes of 20.6 cm (8.125 in), 15.2 cm (6.0 in), and 13.0 cm (5.125 in). All gillnets were composed of mono twist filament webbing dyed Tairyo shade #T-14 (a translucent light green). Twine size was dependent upon mesh size, with 13.0 cm and 15.2 cm mesh gillnets having a Tairyo #12 twine size, and 20.6 cm mesh gillnets having a Tairyo #18 twine size. Gillnet depth was 45 mesh (approximately 4–5 m deep) for the 13.0 cm mesh gillnets, 45 cm mesh for the 15.2 cm mesh gillnets, and 29 mesh (approximately 5–6 m deep) for the 20.6 cm mesh gillnets. These depths were selected to sample the entire water column.

Test fishing was conducted just downstream of the transducers so that catches would be as representative as possible of the migrating stream of fish passing through the ensonified zone. Because of the possibility that species composition may differ with respect to distance from shore, as well as between river banks, the river was divided into 4 separate strata (Left Inshore, Left Offshore, Right Inshore, and Right Offshore). Inshore drifts started with 1 end on the bank, while offshore drifts started with the inshore end of the net deployed 10 m from shore.

During the period of peak sockeye salmon passage (from 19 June through 12 July); drift sessions were conducted 3 times daily: morning (0800–1100), mid-day (1300–1600), and evening (1800–2100). Prior to 18 June, and after 13 July, drift sessions were conducted twice daily: mid-morning (0800 to 1100) and early evening (1600–1900). During each drift session, each mesh size was fished for a targeted time of 2.5 minutes per drift. During periods of high catches, drift times were shortened. Drifts were not conducted at night for safety reasons. During periods of peak passage there were 6 drifts per day with each mesh size and strata and during off peak periods there were 4 drifts per day.

SPECIES COMPOSITION ESTIMATES

The daily escapement estimate by species was calculated by applying the CPUE generated through test fishing to the sonar counts for each stratum. The test fishing unit of effort was catch per fathom-hour.

While gillnets are very selective, Miller et al. (1994b) and Miller (1995) found no discernible size selectivity for sockeye, Chinook, or chum salmon with 13.0 cm and 15.2 cm mesh gillnets. The 20.6 cm mesh gillnet, however, tended to select for large sockeye and chum salmon. Therefore, only 13.0 cm and 15.2 cm mesh data were used to apportion sockeye and chum salmon, while data from all 3 mesh sizes (13.0 cm, 15.2 cm, and 20.6 cm) were used to apportion Chinook salmon (Brannian et al. 1995).

To estimate fishing effort, we measured fishing time (FT) to the nearest second and recorded it in decimal minutes. We calculated each drift as

$$FT = RI - FD , \quad (1)$$

where FD was the point in time when the net was fully deployed and RI was the point in time when net retrieval began. The number of fathom-hours (FH) was

$$FH = \frac{fFT}{60} , \quad (2)$$

where f was net length in fathoms (generally 10). The CPUE for each salmon species (group) was based on a specific subset of gillnet mesh sizes, specified above. The CPUE for each species (i) during session j in stratum k was calculated by summing the number caught (C_{ijkmn}) across mesh size (m) and drift (n):

$$CPUE_{ijk} = \frac{\sum_{m=1}^3 \sum_{n=1}^6 u_{im} C_{ijkmn}}{\sum_{m=1}^3 \sum_{n=1}^6 u_{im} FH_{jkmn}} , \quad (3)$$

where u_{im} equals 1 if species i from mesh m is used to estimate species composition, and u_{im} equals 0 otherwise.

The CPUE was summed across drift sessions to create a time and area stratified estimate of species composition. The duration of a time stratum (report period) varied by range and bank and was specified as an input file. The minimum sample size for each time-area stratum was 5 salmon. The rational for the 5-fish minimum sample size was outlined in Brazil (2008). If less than 5 salmon were captured during a day in an area stratum, catches from previous days (all mesh sizes) were added until the minimum sample size was met. The CPUE of species i in period t and stratum k was the sum across all days j :

$$CPUE_{itk} = \sum_{j=1}^{j^k} CPUE_{ijk} . \quad (4)$$

The proportion of species i for report period t^k and area stratum k (S_{itk}) was estimated by:

$$\hat{S}_{itk} = \frac{CPUE_{itk}}{\sum_{i=1}^5 CPUE_{itk}} . \quad (5)$$

To estimate the variance, we assumed that the number of each species caught has a multinomial distribution. Because sampling effort was fairly constant for all drifts within each time period and area stratum, sample size was equal to the total number of fish caught during a time period within an area stratum. The variance of \hat{S}_{itk} was

$$Var(\hat{S}_{itk}) = \frac{\hat{S}_{itk}(1 - \hat{S}_{itk})}{C_{tk} - 1} . \quad (6)$$

Ideally, we would have stratified the estimates of species proportion by drift session (2 or 3 drift sessions per time period). Unfortunately, sample sizes were often too small (<5 fish total) to estimate species proportion during each drift session. Therefore, the variance estimate for each time t and area stratum k was probably underestimated because it did not include variance by drift session.

SALMON ESCAPEMENT ESTIMATES

We derived estimates of species escapements and associated variances from the DIDSON system for comparative purposes. Sonar personnel completed a single 10 minute count per hour per stratum (left bank inshore, left bank offshore, right bank inshore, right bank offshore). The total count (\hat{n}_{tk}) for time period t and stratum k was:

$$\hat{n}_{tk} = \sum_{h=1}^{h^t} 6\hat{n}_{tkh}, \quad (7)$$

where, \hat{n}_{tkh} was a 10 minute count conducted during hour h within period t^k and stratum k . Note that there were h^{tk} hours in period t^k .

We expanded 10 minute counts into hourly estimates, and estimated variance using Wolter's (1984, 1985) V5 estimator for systematic sampling schemes. This was the least biased and most efficient estimator of variance when estimating salmon escapements with systematic sampling (Reynolds et al. 2007). It was not possible to develop unbiased estimates of variance with a systematic sampling scheme (Cochran 1977; Wolter 1984, 1985) without stratified random sampling which is not feasible in this case because of the limited crew size. The variance was estimated as:

$$Var(\hat{n}_{tkh}) = \frac{(1-f)}{h^{tk}(3.5(h^{tk}-4))} \sum_{h=1}^{h^k} \left(\frac{n_{kh}}{2} - n_{kh-1} + n_{kh-2} - n_{kh-3} + \frac{n_{kh-4}}{2} \right)^2, \quad (8)$$

where, f = sampling rate, leading to:

$$Var(\hat{n}_{tk}) = (6h^{tk})^2 Var(\hat{n}_{tkh}). \quad (9)$$

We apportioned sonar counts for each area stratum (left and right bank, inshore and offshore) to species for the period t . The time period escapement estimates for each salmon species and area stratum (\hat{N}_{itk}) were based on estimates of species proportions (\hat{S}_{itk}) from escapement sampling and period sonar counts (\hat{n}_{tk}) where:

$$\hat{N}_{itk} = \hat{S}_{itk} \hat{n}_{tk}. \quad (10)$$

By summing area strata estimates, time period escapement (\hat{N}_{it}) estimates by species were estimated as:

$$\hat{N}_{it} = \sum_{k=1}^4 \hat{N}_{itk}. \quad (11)$$

We followed Goodman (1960) to calculate the variance of \hat{N}_{ijk} :

$$Var(\hat{N}_{ijk}) = \hat{n}_{ik}^2 Var(\hat{S}_{ik}) + \hat{S}_{ik}^2 Var(\hat{n}_{ik}) - Var(\hat{n}_{ik})Var(\hat{S}_{ik}). \quad (12)$$

The total variance, $V(\hat{N}_{it})$, across all strata was

$$V(\hat{N}_{it}) = \sum_{k=1}^4 Var(\hat{N}_{ik}). \quad (13)$$

We derived cumulative escapement estimates by summing daily estimates, with the total variance equal to the sum of the daily variances.

AGE, SEX, LENGTH, AND GENETIC SAMPLING

Sonar personnel collected age, sex, and length (ASL) data from sockeye, Chinook, and chum salmon migrating past the sonar site. Prior to 1995, we sampled only sockeye and chum salmon captured with beach seines to avoid size selectivity associated with gillnets (Miller et al. 1994a, 1994b; Miller 1995). However, in 1992, Miller et al. (1994a) found that fish caught with 13.0 cm and 15.2 cm mesh gillnets had length frequency distributions similar to those caught with beach seines, particularly for sockeye salmon caught with 13.0 cm mesh gillnets. Based on this information, we collected sockeye salmon ASL data from fish caught with 13.0 cm and 15.2 cm mesh gillnets, in addition to beach seines, beginning in 1995 (Miller 1996). Between 1996 and 2003, sockeye salmon ASL information was collected only from fish caught with 13.0 cm mesh gillnets and beach seines. Beginning in 2004, sockeye and chum salmon ASL information was collected from fish caught with 13.0 cm and 15.2 cm mesh gillnets. We sampled all captured Chinook salmon regardless of gear type, gillnet mesh size, or catch location to increase sample sizes.

We estimated fish age by examining scales (Mosher 1968). Scales were collected from the left side of the fish approximately 2 rows above the lateral line in an area crossed by a diagonal from the posterior insertion of the dorsal fin to the anterior insertion of the anal fin (INPFC 1963). Because of the high rate of scale loss and regeneration among Chinook salmon, 3 scales were sampled per fish. Sockeye and chum salmon were sampled with 1 scale per fish. Scales were mounted on gummed cards with impressions imbedded in cellulose acetate using a heated press (Clutter and Whitesel 1956). We used European notation, where numerals preceding the decimal refer to the number of freshwater annuli and numerals following the decimal refer to the number of marine annuli (Koo 1962). The total age of a fish, from the time of egg deposition (brood year), was the sum of these 2 numbers plus 1 to account for incubation time.

A sampling goal of 480 salmon per stratum allowed us to estimate the proportion of each age class within 5% of the true value 90% of the time (Thompson 1987). This sample size took in to account the approximately 20% of the scales that are regenerated, reabsorbed or otherwise illegible (Tim Baker, Commercial Fisheries Biologist, ADF&G, Anchorage, personal communication). Sampling was stratified by time period (early, middle, and late run) in the case of sockeye salmon. Chinook and chum samples were not stratified by time. Therefore, our season total sampling goals summed to 1,440 sockeye, 480 Chinook, and 480 chum salmon. This level of sampling ensured the objective criteria were met for objectives 3 and 4. Estimates of age composition were compared postseason for sockeye salmon between time strata using a chi-square analysis (Snedecor and Cochran 1980).

We estimated age and sex composition as a series of proportions (p_{ias}) of a multinomial distribution of age (a), sex (s), and species (i):

$$\hat{p}_{ias} = n_{ias}/n_{it}, \quad (14)$$

where, n_{it} is the sample counted in period t and species i and n_{ias} is the number of age a and sex s counted in period t by species i . The marginal proportion for each combination of age and sex, along with estimates of the proportions' variance (Cochran 1977) was estimated as:

$$Var(\hat{p}_{ias}) = \frac{\hat{p}_{ias}(1 - \hat{p}_{ias})}{n_{it} - 1}. \quad (15)$$

We calculated the standard error of length (ℓ) by species, age, sex, and period of fish sampled in the escapement as:

$$se(\bar{\ell}_{iast}) = \frac{1}{n_{iast}} \sqrt{\frac{\sum_{k=1}^{n_{iast}} (\ell_{iastk} - \bar{\ell}_{iast})^2}{n_{iast} - 1}}, \quad (16)$$

where, $\bar{\ell}_{iast}$ was the mean length of species i , age a , sex s , during period t , and ℓ_{iastk} represents the length of fish k of species i , age a , sex s , and period t , and n_{iast} was the number of fish of species i , age a , sex s , during period t . We measured salmon from the mideye to tail fork, and recorded lengths to the nearest 5 mm. In all species, sex was determined from external morphological characteristics.

MIGRATORY TIMING

We calculated the average daily passage for sockeye, Chinook, and chum salmon using all years of sonar data. Average daily proportions (\bar{p}_j) were calculated as the sum of daily proportions (p_{ji}) for all years, divided by the total number of years (Y):

$$\bar{p}_j = \frac{\sum_{i=1}^Y p_{ji}}{Y}. \quad (17)$$

Average cumulative proportions by day were the sum of average daily proportions through time.

We compared the 2007 run to the desired escapement goal or objective for each species. The average daily cumulative proportions for each species were multiplied by their respective escapement goal or objective as follows: 550,000 for sockeye salmon, the midpoint of the escapement goal range of 340,000–760,000; 75,000 for Chinook salmon, the inriver goal; and 190,000 for chum salmon, the lower bound escapement goal.

ENVIRONMENTAL DATA

Weather data was collected at approximately 0800 and 2000 hours each day. The sonar crew measured precipitation to the nearest mm using a Taylor Clear View rain gauge, air temperatures to the nearest 0.1 C using an Oregon Scientific digital thermometer, and wind direction and velocity (km/h) using a Weathertronics anemometer.

RESULTS

HYDROACOUSTIC COUNTING

Hydroacoustic counting began just after midnight on the evening of 5 June on the left bank and 24 h later on the right bank and ended at 1200 18 July on both banks. A total of 1,004,555 individual salmon sized acoustic targets were recorded in 2009 (Table 1). Sonar count distribution by bank varied throughout the season with counts at the end of the season totaling 589,828 (58.7%) on the left bank and 414,727 (41.3%) on the right bank. The 2 inshore strata accounted for 74.6% of the total sonar count. The inshore stratum accounted for 71.2% of the left bank count and 79.6% of the right bank count (Table 1; Appendices A1–A4).

Spatial and Temporal Distribution of Sonar Counts

Peak daily passage occurred on 24 June in all strata except the left bank offshore strata where it occurred on 20 June (Table 1; Appendix A1–A4).

Hourly fish passage from 4 June to 19 July varied within and among strata. Peak counts on the left bank occurred at 2200 inshore and at 1900 offshore and counts were lowest at 0800 inshore and 0400 offshore (Figure 2). Peak counts on the right bank occurred at 2200 inshore and 1900 offshore and counts were lowest at 0400 inshore and offshore on the right bank (Figure 3).

Escapement Sampling

In 2009, a total of 2,856 gillnet drifts were completed. The duration of each gillnet drift was approximately 2.5 minutes. The 13.0 cm, 15.2 cm, and 20.6 cm mesh gillnets caught 2,840 salmon; 1,273 sockeye, 268 Chinook, 1,298 chum, and 1 coho (Table 2). Most were caught in the inshore stratum; 1,124 on the left bank and 931 on the right (Table 2).

The 13.0 cm gillnet caught the greatest number of sockeye salmon (560), followed by the 15.2 cm (501), and 20.6 cm (212) mesh gillnets. Chinook salmon were captured in similar numbers in each mesh; 76 in 13.0 cm mesh, 112 in 15.2 cm mesh and 80 in 20.6 cm mesh gillnet. Chum salmon were caught predominantly in both the 13.0 cm mesh gillnet (533), and 15.2 cm mesh gillnet (658), with only 107 caught in 20.6 cm mesh gillnet (Table 2). Sockeye, Chinook, and chum salmon dominated the catches throughout June and July (Tables 3, 4, 5, and 6).

Estimates of Escapement

The overall salmon escapement estimate for Nushagak River in 2009 was 1,004,565 fish (standard error (SE) = 21,285). This included an estimated 484,149 sockeye (SE = 15,810; CI of $\pm 20,968$), 81,480 Chinook (SE = 4,872; CI of $\pm 8,836$), and 438,481 chum (SE = 13,392; CI of $\pm 20,043$), salmon (Tables 7 and 8).

Sockeye Salmon

Sockeye salmon were first counted on 12 June when they accounted for 2% of the salmon passage on that day and 46% on 18 July when counting stopped. Daily passage ranged from 32 fish on 12 June to 38,920 fish on 24 June (Tables 7 and 9; Figure 4). Most sockeye salmon, 259,419 fish (54%) passed the left bank while 224,730 fish (46%) passed the right bank. On both banks, most sockeye salmon passed through the inshore strata (93% on the left bank and 86% on the right bank). Peak passage occurred on 7 July in the left bank offshore stratum, on 9 July in the left bank inshore stratum, 6 July in the right bank offshore stratum and on 24 June in the right

bank inshore stratum (Table 10). The point at which the cumulative escapement reached 50% of the final escapement was 1 day earlier than the average throughout the 2000s and 4 days earlier than the 1990s (Figure 4).

Chinook Salmon

Chinook salmon were first counted on 9 June when they accounted for 18% of the salmon passage and 1% on 18 July when counting stopped. Daily passage ranged from 33 fish on 18 July to 11,860 fish on 20 June (Tables 7, 10, and 11; Figure 5). Most Chinook salmon, 67,949 fish (83%) passed on the left bank while 13,531 fish (17%) passed the right bank. On both banks, most Chinook salmon passed through the offshore strata (84% on the left bank and 75% on the right bank). Peak passage occurred on 21 June in the left bank offshore stratum, on 23 June in the left bank inshore stratum, 30 June in the right bank offshore stratum and on 23 June in the right bank inshore stratum (Table 10). The point at which the cumulative escapement reached 50% of the final escapement was 2 days earlier than the average throughout the 2000s and 4 days earlier than the 1990s (Figure 5).

Chum Salmon

Chum salmon accounted for 100% of the salmon passage when counting began on 6 June and 54% on 18 July when counting stopped. Daily passage ranged from 587 fish on 16 June to 44,754 fish on 24 June (Tables 7, 10, and 12; Figure 6). Most chum salmon, 262,009 fish (60%) passed the left bank while 176,472 fish (40.2%) passed the right bank. On both banks, most chum salmon passed through the inshore strata (64% on the left bank and 75% on the right bank). Peak passage occurred in all strata on 24 June except the left bank offshore stratum which saw peak chum salmon passage on 7 July (Table 10). The point at which the cumulative escapement reached 50% of the final escapement was 1 day earlier than the average throughout the 2000s and 5 days earlier than the 1990s (Figure 6).

Age, Sex, and Size Estimates

Sockeye salmon age, sex, and length composition was estimated for 2 time strata based on 993 readable scales (Table 13). The dominant age class between 6 June and 29 June (Period 1), was age 1.3 (67%; 2004 brood year), followed by age 1.2 (16%; 2005 brood year), and age 1.4 (12%; 2003 brood year). The sex composition during this time was 51% males and 49% females. Mean length by age ranged from 508 mm for age 2.2 to 609 mm for age 0.4. The dominant age class between 30 June and 4 July (Period 2), was age 1.3 (51%), followed by age 1.2 (37%), and age 1.4 (8%). The sex composition during this time was 52% males and 49% females. Mean length by age ranged from 508 mm for age 1.2 to 601 mm for age 1.4. The overall sex composition sampled was 50.6% males and 49.4% females. Mean length by age ranged from 508 mm for age 2.2 to 605 mm for age 1.4 (Tables 13 and 14).

Chinook salmon age, sex, and length composition was estimated based on 230 readable scales (Table 15). Three major age classes were present: age 1.2 (30%; 2005 brood year), age 1.3 (34%; 2004 brood year); and age 1.4 (36%; 2003 brood year). The sex composition was 52% males and 48% females. Mean length by age ranged from 440 mm for age 1.1 to 843 mm for age 1.4 (Table 16).

Chum salmon age, sex, and length composition was estimated based on 366 readable scales (Table 17). The dominant age class was age 0.3 (56%; 2005 brood year), followed by

age 0.4 (44%; 2004 brood year). The sex composition was 56% males and 45% females. Mean length by age ranged from 595 mm for age 0.2 to 634 mm for age 0.4 fish (Table 18).

Genetic Sampling

No genetic samples were collected from salmon passing the sonar site in 2009.

Environmental Data

Air temperature was approximately 1 degree below average during June and 3 degrees above in July. Water temperatures were slightly colder than average in June and about 2 degrees warmer in July (Table 19; Appendix B1).

DISCUSSION

The purpose of this study was to estimate the escapement of Pacific salmon into the Nushagak River using sonar. The 2009 season was successful in this respect. The primary objective (Objective 1) of this study was achieved for sockeye Chinook and chum salmon in 2009. The escapement estimate of 484,149 sockeye salmon had a 90% confidence interval (CI) of $\pm 25,928$ fish (within 5.4% of the escapement estimate) and was within the biological escapement goal range of 340,000 to 760,000. Cumulative sockeye escapement in 2009 was slightly higher than the 1990s average but less than the 2000s average (Figure 4). The escapement estimate of 81,480 Chinook salmon had a 90% CI of $\pm 7,990$ fish (within 9.8% of the escapement estimate) and above the inriver goal of 75,000 fish and the SEG upper end of 80,000 fish. The escapement estimate of 438,481 chum salmon had a 90% CI of $\pm 13,392$ fish (within 5.0% of the escapement estimate) and above the escapement objective of 190,000 fish.

Sampling efforts fell short of desired goals for estimating the age composition of sockeye, Chinook and chum salmon in 2009 (Objective 2). The sample size goal of 1,200 sockeye salmon would allow for 3 time strata of 400 samples each distributed across the early, middle, and late portions of the run. The sonar crew produced 993 readable scales in 2009 allowing sockeye age composition estimates for the early and late portions of the escapement (Table 13). Age 1.2 and age 1.3 fish accounted for 86% of the total run (Table 14). The sample size goal for Chinook salmon is 500 fish and the crew sampled 230 Chinook during 2009. Nevertheless, an age composition estimate was made for all major age classes. The escapement was roughly divided between age 1.2, 1.3, and 1.4 fish (Table 15). The sample size goal for chum salmon is 500 fish and the crew sampled 366 during 2009. Nevertheless, an age composition estimate was made for all major age classes. Age 0.3 accounted for a little over half of the escapement while most of the rest of the run was age 0.4 (Table 17).

We estimated the sex composition (Objective 3) and mean length at age by sex (Objective 4) of sockeye, Chinook, and chum salmon for the 2009 season. The total proportion of males (50.6%) was greater than females (49.4%) for sockeye salmon in 2009 and varied over the season (Table 14). There were more males than females in Chinook (51.7% males; 48.3% females; Table 16), and chum (55.5% males; 44.5% females; Table 18) salmon. Male sockeye salmon were larger than females (mean length: 581 mm, males; 547 mm, females; Table 14). However, for Chinook salmon, males were smaller than females (mean length: 690 mm, males; 786 mm, females; Table 16). Male chum salmon were larger than females (mean length: 643 mm, males; 604 mm, females; Table 18).

Typically around two thirds of Chinook will pass through 1 of the left bank strata while around one third of chum and sockeye salmon will do so. In 2009, 54% of sockeye, 83% of chum and 60% of Chinook salmon passed the left bank. Historically, around 40% of Chinook pass through an inshore strata while approximately 95% of sockeye and 80% of chum salmon do as well. In 2009, 18% of Chinook passed through 1 of the inshore strata while 90% of sockeye and 68% of chum salmon did as well.

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TABLES AND FIGURES

Table 1.—Daily inshore and offshore sonar counts by bank, Nushagak River sonar project, 2009.

Date	Left Bank			Right Bank		
	Inshore	Offshore	Cumulative	Inshore	Offshore	Cumulative
6/6	441	418	859	636	288	924
6/7	342	156	498	318	54	372
6/8	438	136	574	552	102	654
6/9	456	438	894	180	108	288
6/10	462	546	1,008	288	174	462
6/11	660	522	1,182	438	288	726
6/12	318	450	768	426	258	684
6/13	342	408	750	510	180	690
6/14	336	798	1,134	234	168	402
6/15	336	2,232	2,568	396	798	1,194
6/16	383	1,165	1,548	708	374	1,082
6/17	210	513	723	858	282	1,140
6/18	120	918	1,038	906	660	1,566
6/19	2,688	10,944	13,632	2,574	1,003	3,577
6/20	9,756	16,326	26,082	6,894	3,054	9,948
6/21	32,268	8,947	41,215	15,258	2,634	17,892
6/22	23,724	4,327	28,051	14,316	2,106	16,422
6/23	39,912	5,088	45,000	31,493	3,499	34,992
6/24	41,719	5,515	47,234	36,156	4,638	40,794
6/25	32,760	5,514	38,274	31,182	3,504	34,686
6/26	18,576	3,024	21,600	19,248	3,180	22,428
6/27	14,742	2,616	17,358	11,262	2,592	13,854
6/28	7,836	2,910	10,746	10,632	2,064	12,696
6/29	12,636	3,114	15,750	15,984	2,256	18,240
6/30	21,473	4,332	25,805	16,230	3,768	19,998
7/1	18,726	5,783	24,509	17,100	3,216	20,316
7/2	14,042	4,662	18,704	10,146	2,059	12,205
7/3	4,783	3,048	7,831	5,772	1,315	7,087
7/4	10,740	9,630	20,370	10,188	3,126	13,314
7/5	21,306	10,740	32,046	10,854	4,122	14,976
7/6	8,208	9,901	18,109	4,878	3,300	8,178
7/7	8,058	15,534	23,592	8,410	3,907	12,317
7/8	13,596	7,236	20,832	7,218	3,252	10,470
7/9	25,200	8,406	33,606	10,662	3,805	14,467
7/10	14,736	2,964	17,700	3,834	2,826	6,660
7/11	6,090	1,740	7,830	3,144	2,016	5,160
7/12	2,682	1,092	3,774	3,882	3,102	6,984
7/13	3,498	360	3,858	5,004	1,399	6,403
7/14	1,800	1,392	3,192	4,158	2,034	6,192
7/15	1,740	1,908	3,648	2,418	2,010	4,428
7/16	420	1,692	2,112	678	1,746	2,424
7/17	948	1,686	2,634	2,274	2,046	4,320
7/18	378	816	1,194	1,716	1,405	3,121
Total	419,885	169,947	589,832	330,015	84,718	414,733

Table 2.—Drift gillnet catch by mesh size and salmon species, Nushagak River sonar project, 2009.

Gillnet Mesh Size	Species	Drift Stratum					
		Left Bank			Right Bank		
Inshore	Offshore	Total	Inshore	Offshore	Total		
13.0 cm	Sockeye	269	14	283	210	67	277
	Chinook	11	35	46	6	24	30
	Chum	202	49	251	187	95	282
	Coho						
15.2 cm	Sockeye	221	21	242	206	53	259
	Chinook	21	56	77	9	26	35
	Chum	251	130	381	172	105	277
	Coho		1	1			
20.6 cm	Sockeye	82	8	90	110	12	122
	Chinook	17	46	63	3	14	17
	Chum	50	10	60	28	19	47
	Coho						
All Meshes	Sockeye	572	43	615	526	132	658
	Chinook	49	137	186	18	64	82
	Chum	503	189	692	387	219	606
	Coho		1	1			

Table 3.—Left bank inshore stratum escapement sampling catch proportions by date, drift session, and salmon species, 2009.

Date	Session	Catch	Proportion of Catch				
			Sockeye	Chinook	Chum	Coho	Pink
6/6	1	0	0.00	0.00	0.00	0.00	0.00
6/6	2	0	0.00	0.00	0.00	0.00	0.00
6/6	3	0	0.00	0.00	0.00	0.00	0.00
6/7	1	2	0.00	0.00	1.00	0.00	0.00
6/7	2	0	0.00	0.00	0.00	0.00	0.00
6/7	3	1	0.00	0.00	1.00	0.00	0.00
6/8	1	5	0.00	0.00	1.00	0.00	0.00
6/8	2	0	0.00	0.00	0.00	0.00	0.00
6/8	3	1	0.00	0.00	1.00	0.00	0.00
6/9	1	3	0.00	0.00	1.00	0.00	0.00
6/9	2	0	0.00	0.00	0.00	0.00	0.00
6/9	3	3	0.00	1.00	0.00	0.00	0.00
6/10	1	2	0.00	0.00	1.00	0.00	0.00
6/10	2	0	0.00	0.00	0.00	0.00	0.00
6/10	3	2	0.00	0.00	1.00	0.00	0.00
6/11	1	4	0.00	0.00	1.00	0.00	0.00
6/11	2	0	0.00	0.00	0.00	0.00	0.00
6/11	3	2	0.00	0.00	1.00	0.00	0.00
6/12	1	1	0.00	0.00	1.00	0.00	0.00
6/12	2	0	0.00	0.00	0.00	0.00	0.00
6/12	3	3	0.33	0.00	0.67	0.00	0.00
6/13	1	1	0.00	0.00	1.00	0.00	0.00
6/13	2	0	0.00	0.00	0.00	0.00	0.00
6/13	3	1	0.00	0.00	1.00	0.00	0.00
6/14	1	1	0.00	1.00	0.00	0.00	0.00
6/14	2	0	0.00	0.00	0.00	0.00	0.00
6/14	3	3	0.00	1.00	0.00	0.00	0.00
6/15	1	4	0.00	0.50	0.50	0.00	0.00
6/15	2	0	0.00	0.00	0.00	0.00	0.00
6/15	3	12	0.00	0.00	1.00	0.00	0.00
6/16	1	2	0.50	0.00	0.50	0.00	0.00
6/16	2	0	0.00	0.00	0.00	0.00	0.00
6/16	3	3	0.00	0.00	1.00	0.00	0.00
6/17	1	1	1.00	0.00	0.00	0.00	0.00
6/17	2	0	0.00	0.00	0.00	0.00	0.00
6/17	3	1	0.00	1.00	0.00	0.00	0.00
6/18	1	0	0.00	0.00	0.00	0.00	0.00
6/18	2	0	0.00	0.00	0.00	0.00	0.00
6/18	3	4	0.50	0.00	0.50	0.00	0.00
6/19	1	19	0.00	0.00	1.00	0.00	0.00
6/19	3	23	0.26	0.04	0.70	0.00	0.00
6/20	1	9	0.22	0.00	0.78	0.00	0.00
6/20	2	12	0.33	0.25	0.42	0.00	0.00
6/20	3	28	0.43	0.04	0.54	0.00	0.00

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Table 3.–Page 2 of 3.

Date	Session	Catch	Proportion of Catch				
			Sockeye	Chinook	Chum	Coho	Pink
6/21	1	22	0.45	0.09	0.45	0.00	0.00
6/21	2	18	0.28	0.11	0.61	0.00	0.00
6/21	3	26	0.38	0.00	0.62	0.00	0.00
6/22	1	30	0.67	0.00	0.33	0.00	0.00
6/22	2	21	0.57	0.24	0.19	0.00	0.00
6/22	3	22	0.64	0.05	0.32	0.00	0.00
6/23	1	36	0.42	0.03	0.56	0.00	0.00
6/23	2	19	0.21	0.16	0.63	0.00	0.00
6/23	3	39	0.59	0.03	0.38	0.00	0.00
6/24	1	50	0.30	0.02	0.68	0.00	0.00
6/24	2	36	0.56	0.03	0.42	0.00	0.00
6/24	3	34	0.68	0.00	0.32	0.00	0.00
6/25	1	24	0.46	0.00	0.54	0.00	0.00
6/25	2	37	0.59	0.08	0.32	0.00	0.00
6/25	3	18	0.67	0.00	0.33	0.00	0.00
6/26	1	13	0.23	0.00	0.77	0.00	0.00
6/26	2	25	0.32	0.16	0.52	0.00	0.00
6/26	3	14	0.29	0.00	0.71	0.00	0.00
6/27	1	13	0.38	0.00	0.62	0.00	0.00
6/27	2	17	0.35	0.00	0.65	0.00	0.00
6/27	3	8	0.25	0.00	0.75	0.00	0.00
6/28	1	7	0.57	0.14	0.29	0.00	0.00
6/28	2	23	0.22	0.04	0.74	0.00	0.00
6/28	3	5	0.00	0.20	0.80	0.00	0.00
6/29	1	13	0.54	0.00	0.46	0.00	0.00
6/29	2	27	0.48	0.04	0.48	0.00	0.00
6/29	3	5	0.60	0.00	0.40	0.00	0.00
6/30	1	7	0.71	0.00	0.29	0.00	0.00
6/30	2	14	0.86	0.00	0.14	0.00	0.00
6/30	3	13	0.38	0.08	0.54	0.00	0.00
7/1	1	12	0.75	0.00	0.25	0.00	0.00
7/1	2	27	0.85	0.00	0.15	0.00	0.00
7/1	3	10	0.70	0.00	0.30	0.00	0.00
7/2	1	20	0.80	0.00	0.20	0.00	0.00
7/2	2	13	0.77	0.00	0.23	0.00	0.00
7/2	3	18	0.39	0.06	0.56	0.00	0.00
7/3	1	1	1.00	0.00	0.00	0.00	0.00
7/3	2	9	0.33	0.11	0.56	0.00	0.00
7/3	3	12	0.42	0.00	0.58	0.00	0.00
7/4	1	7	1.00	0.00	0.00	0.00	0.00
7/4	2	18	0.44	0.00	0.56	0.00	0.00
7/4	3	13	0.62	0.08	0.31	0.00	0.00
7/5	1	9	0.89	0.00	0.11	0.00	0.00
7/5	2	14	0.71	0.07	0.21	0.00	0.00
7/5	3	14	0.93	0.00	0.07	0.00	0.00

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Table 3.–Page 3 of 3.

Date	Session	Catch	Proportion of Catch				
			Sockeye	Chinook	Chum	Coho	Pink
7/6	1	8	0.88	0.00	0.13	0.00	0.00
7/6	2	9	0.44	0.00	0.56	0.00	0.00
7/6	3	1	1.00	0.00	0.00	0.00	0.00
7/7	1	11	0.91	0.00	0.09	0.00	0.00
7/7	2	2	1.00	0.00	0.00	0.00	0.00
7/7	3	4	0.50	0.00	0.50	0.00	0.00
7/8	1	2	0.50	0.00	0.50	0.00	0.00
7/8	2	13	0.77	0.00	0.23	0.00	0.00
7/8	3	12	0.92	0.00	0.08	0.00	0.00
7/9	1	7	0.57	0.00	0.43	0.00	0.00
7/9	2	19	0.89	0.00	0.11	0.00	0.00
7/9	3	8	0.88	0.00	0.13	0.00	0.00
7/10	1	5	1.00	0.00	0.00	0.00	0.00
7/10	2	8	0.88	0.00	0.13	0.00	0.00
7/10	3	2	1.00	0.00	0.00	0.00	0.00
7/11	1	1	1.00	0.00	0.00	0.00	0.00
7/11	2	3	1.00	0.00	0.00	0.00	0.00
7/11	3	3	0.33	0.00	0.67	0.00	0.00
7/12	1	5	0.80	0.00	0.20	0.00	0.00
7/12	2	2	0.00	0.00	1.00	0.00	0.00
7/12	3	1	1.00	0.00	0.00	0.00	0.00
7/13	1	3	1.00	0.00	0.00	0.00	0.00
7/13	2	0	0.00	0.00	0.00	0.00	0.00
7/13	3	0	0.00	0.00	0.00	0.00	0.00
7/14	1	3	1.00	0.00	0.00	0.00	0.00
7/14	2	0	0.00	0.00	0.00	0.00	0.00
7/14	3	2	0.50	0.00	0.50	0.00	0.00
7/15	1	1	1.00	0.00	0.00	0.00	0.00
7/15	2	0	0.00	0.00	0.00	0.00	0.00
7/15	3	0	0.00	0.00	0.00	0.00	0.00
7/16	1	0	0.00	0.00	0.00	0.00	0.00
7/16	2	0	0.00	0.00	0.00	0.00	0.00
7/16	3	0	0.00	0.00	0.00	0.00	0.00
7/17	1	2	1.00	0.00	0.00	0.00	0.00
7/17	2	0	0.00	0.00	0.00	0.00	0.00
7/17	3	1	0.00	1.00	0.00	0.00	0.00
7/18	1	0	0.00	0.00	0.00	0.00	0.00
7/18	2	0	0.00	0.00	0.00	0.00	0.00
7/18	3	0	0.00	0.00	0.00	0.00	0.00

Table 4.—Left bank offshore stratum escapement sampling catch proportions by date, drift session, and salmon species, 2009.

Date	Session	Catch	Proportion of Catch				
			Sockeye	Chinook	Chum	Coho	Pink
6/6	1	0	0.00	0.00	0.00	0.00	0.00
6/6	2	0	0.00	0.00	0.00	0.00	0.00
6/6	3	0	0.00	0.00	0.00	0.00	0.00
6/7	1	0	0.00	0.00	0.00	0.00	0.00
6/7	2	0	0.00	0.00	0.00	0.00	0.00
6/7	3	1	0.00	0.00	1.00	0.00	0.00
6/8	1	0	0.00	0.00	0.00	0.00	0.00
6/8	2	0	0.00	0.00	0.00	0.00	0.00
6/8	3	0	0.00	0.00	0.00	0.00	0.00
6/9	1	2	0.00	0.00	1.00	0.00	0.00
6/9	2	0	0.00	0.00	0.00	0.00	0.00
6/9	3	0	0.00	0.00	0.00	0.00	0.00
6/10	1	1	0.00	1.00	0.00	0.00	0.00
6/10	2	0	0.00	0.00	0.00	0.00	0.00
6/10	3	1	0.00	1.00	0.00	0.00	0.00
6/11	1	0	0.00	0.00	0.00	0.00	0.00
6/11	2	0	0.00	0.00	0.00	0.00	0.00
6/11	3	0	0.00	0.00	0.00	0.00	0.00
6/12	1	1	0.00	1.00	0.00	0.00	0.00
6/12	2	0	0.00	0.00	0.00	0.00	0.00
6/12	3	0	0.00	0.00	0.00	0.00	0.00
6/13	1	2	0.00	0.50	0.50	0.00	0.00
6/13	2	0	0.00	0.00	0.00	0.00	0.00
6/13	3	0	0.00	0.00	0.00	0.00	0.00
6/14	1	1	0.00	1.00	0.00	0.00	0.00
6/14	2	0	0.00	0.00	0.00	0.00	0.00
6/14	3	0	0.00	0.00	0.00	0.00	0.00
6/15	1	5	0.00	1.00	0.00	0.00	0.00
6/15	2	0	0.00	0.00	0.00	0.00	0.00
6/15	3	0	0.00	0.00	0.00	0.00	0.00
6/16	1	2	0.00	1.00	0.00	0.00	0.00
6/16	2	0	0.00	0.00	0.00	0.00	0.00
6/16	3	2	0.00	1.00	0.00	0.00	0.00
6/17	1	0	0.00	0.00	0.00	0.00	0.00
6/17	2	0	0.00	0.00	0.00	0.00	0.00
6/17	3	1	0.00	0.00	1.00	0.00	0.00
6/18	1	0	0.00	0.00	0.00	0.00	0.00
6/18	2	0	0.00	0.00	0.00	0.00	0.00
6/18	3	1	0.00	1.00	0.00	0.00	0.00
6/19	1	0	0.00	0.00	0.00	0.00	0.00
6/19	3	2	0.00	1.00	0.00	0.00	0.00
6/20	1	3	0.00	0.67	0.33	0.00	0.00
6/20	2	2	0.00	0.00	1.00	0.00	0.00
6/20	3	7	0.00	0.86	0.14	0.00	0.00

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Table 4.—Page 2 of 3.

Date	Session	Catch	Proportion of Catch				
			Sockeye	Chinook	Chum	Coho	Pink
6/21	1	5	0.20	0.20	0.60	0.00	0.00
6/21	2	5	0.00	0.40	0.60	0.00	0.00
6/21	3	12	0.33	0.25	0.42	0.00	0.00
6/22	1	4	0.00	0.75	0.25	0.00	0.00
6/22	2	6	0.17	0.67	0.17	0.00	0.00
6/22	3	4	0.00	0.75	0.25	0.00	0.00
6/23	1	6	0.00	0.50	0.50	0.00	0.00
6/23	2	9	0.11	0.56	0.33	0.00	0.00
6/23	3	8	0.00	0.38	0.63	0.00	0.00
6/24	1	10	0.00	0.50	0.50	0.00	0.00
6/24	2	5	0.20	0.20	0.60	0.00	0.00
6/24	3	8	0.13	0.63	0.25	0.00	0.00
6/25	1	14	0.07	0.14	0.79	0.00	0.00
6/25	2	4	0.00	0.25	0.75	0.00	0.00
6/25	3	4	0.75	0.00	0.25	0.00	0.00
6/26	1	6	0.33	0.00	0.67	0.00	0.00
6/26	2	5	0.20	0.40	0.40	0.00	0.00
6/26	3	8	0.00	0.25	0.75	0.00	0.00
6/27	1	5	0.00	0.60	0.40	0.00	0.00
6/27	2	3	0.00	0.33	0.67	0.00	0.00
6/27	3	6	0.00	0.83	0.17	0.00	0.00
6/28	1	6	0.00	0.67	0.33	0.00	0.00
6/28	2	0	0.00	0.00	0.00	0.00	0.00
6/28	3	1	0.00	0.00	1.00	0.00	0.00
6/29	1	4	0.00	1.00	0.00	0.00	0.00
6/29	2	4	0.00	0.75	0.25	0.00	0.00
6/29	3	3	0.00	1.00	0.00	0.00	0.00
6/30	1	10	0.10	0.60	0.30	0.00	0.00
6/30	2	9	0.56	0.11	0.33	0.00	0.00
6/30	3	7	0.00	0.14	0.86	0.00	0.00
7/1	1	7	0.00	0.43	0.57	0.00	0.00
7/1	2	1	1.00	0.00	0.00	0.00	0.00
7/1	3	4	0.50	0.25	0.25	0.00	0.00
7/2	1	2	0.00	1.00	0.00	0.00	0.00
7/2	2	9	0.11	0.22	0.67	0.00	0.00
7/2	3	0	0.00	0.00	0.00	0.00	0.00
7/3	1	4	0.00	0.75	0.25	0.00	0.00
7/3	2	2	0.50	0.00	0.50	0.00	0.00
7/3	3	8	0.25	0.13	0.63	0.00	0.00
7/4	1	4	0.00	0.75	0.25	0.00	0.00
7/4	2	0	0.00	0.00	0.00	0.00	0.00
7/4	3	0	0.00	0.00	0.00	0.00	0.00
7/5	1	3	0.00	1.00	0.00	0.00	0.00
7/5	2	4	0.00	0.25	0.75	0.00	0.00

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Table 4.–Page 3 of 3.

Date	Session	Catch	Proportion of Catch				
			Sockeye	Chinook	Chum	Coho	Pink
7/5	3	6	0.17	0.00	0.83	0.00	0.00
7/6	1	2	0.00	1.00	0.00	0.00	0.00
7/6	2	11	0.18	0.27	0.55	0.00	0.00
7/6	3	11	0.18	0.18	0.64	0.00	0.00
7/7	1	1	1.00	0.00	0.00	0.00	0.00
7/7	2	9	0.22	0.00	0.78	0.00	0.00
7/7	3	8	0.00	0.13	0.88	0.00	0.00
7/8	1	0	0.00	0.00	0.00	0.00	0.00
7/8	2	0	0.00	0.00	0.00	0.00	0.00
7/8	3	3	0.00	0.33	0.67	0.00	0.00
7/9	1	2	0.00	0.00	1.00	0.00	0.00
7/9	2	1	0.00	0.00	1.00	0.00	0.00
7/9	3	14	0.00	0.00	1.00	0.00	0.00
7/10	1	1	0.00	0.00	1.00	0.00	0.00
7/10	2	3	0.00	0.00	1.00	0.00	0.00
7/10	3	10	0.30	0.00	0.70	0.00	0.00
7/11	1	3	0.33	0.67	0.00	0.00	0.00
7/11	2	2	1.00	0.00	0.00	0.00	0.00
7/11	3	3	0.00	0.67	0.33	0.00	0.00
7/12	1	2	0.00	0.50	0.50	0.00	0.00
7/12	2	3	0.00	0.33	0.67	0.00	0.00
7/12	3	2	0.00	0.00	1.00	0.00	0.00
7/13	1	0	0.00	0.00	0.00	0.00	0.00
7/13	2	0	0.00	0.00	0.00	0.00	0.00
7/13	3	0	0.00	0.00	0.00	0.00	0.00
7/14	1	0	0.00	0.00	0.00	0.00	0.00
7/14	2	0	0.00	0.00	0.00	0.00	0.00
7/14	3	2	0.00	0.00	1.00	0.00	0.00
7/15	1	0	0.00	0.00	0.00	0.00	0.00
7/15	2	0	0.00	0.00	0.00	0.00	0.00
7/15	3	0	0.00	0.00	0.00	0.00	0.00
7/16	1	2	0.00	0.50	0.50	0.00	0.00
7/16	2	0	0.00	0.00	0.00	0.00	0.00
7/16	3	1	0.00	1.00	0.00	0.00	0.00
7/17	1	2	0.00	0.00	1.00	0.00	0.00
7/17	2	0	0.00	0.00	0.00	0.00	0.00
7/17	3	3	0.00	0.00	0.67	0.33	0.00
7/18	1	0	0.00	0.00	0.00	0.00	0.00
7/18	2	0	0.00	0.00	0.00	0.00	0.00
7/18	3	0	0.00	0.00	0.00	0.00	0.00

Table 5.—Right bank inshore stratum escapement sampling catch proportions by date, drift session, and salmon species, 2009.

Date	Session	Catch	Proportion of Catch				
			Sockeye	Chinook	Chum	Coho	Pink
6/6	1	0	0.00	0.00	0.00	0.00	0.00
6/6	2	0	0.00	0.00	0.00	0.00	0.00
6/6	3	0	0.00	0.00	0.00	0.00	0.00
6/7	1	4	0.00	0.00	1.00	0.00	0.00
6/7	2	0	0.00	0.00	0.00	0.00	0.00
6/7	3	0	0.00	0.00	0.00	0.00	0.00
6/8	1	4	0.00	0.00	1.00	0.00	0.00
6/8	2	0	0.00	0.00	0.00	0.00	0.00
6/8	3	1	0.00	0.00	1.00	0.00	0.00
6/9	1	6	0.00	0.00	1.00	0.00	0.00
6/9	2	0	0.00	0.00	0.00	0.00	0.00
6/9	3	2	0.00	0.00	1.00	0.00	0.00
6/10	1	2	0.00	0.00	1.00	0.00	0.00
6/10	2	0	0.00	0.00	0.00	0.00	0.00
6/10	3	1	0.00	0.00	1.00	0.00	0.00
6/11	1	1	0.00	0.00	1.00	0.00	0.00
6/11	2	0	0.00	0.00	0.00	0.00	0.00
6/11	3	0	0.00	0.00	0.00	0.00	0.00
6/12	1	3	0.00	0.00	1.00	0.00	0.00
6/12	2	0	0.00	0.00	0.00	0.00	0.00
6/12	3	4	0.00	0.00	1.00	0.00	0.00
6/13	1	3	0.00	0.00	1.00	0.00	0.00
6/13	2	0	0.00	0.00	0.00	0.00	0.00
6/13	3	0	0.00	0.00	0.00	0.00	0.00
6/14	1	1	0.00	0.00	1.00	0.00	0.00
6/14	2	0	0.00	0.00	0.00	0.00	0.00
6/14	3	2	0.50	0.00	0.50	0.00	0.00
6/15	1	0	0.00	0.00	0.00	0.00	0.00
6/15	2	0	0.00	0.00	0.00	0.00	0.00
6/15	3	13	0.00	0.38	0.62	0.00	0.00
6/16	1	6	0.33	0.00	0.67	0.00	0.00
6/16	2	0	0.00	0.00	0.00	0.00	0.00
6/16	3	1	0.00	0.00	1.00	0.00	0.00
6/17	1	3	0.00	0.33	0.67	0.00	0.00
6/17	2	0	0.00	0.00	0.00	0.00	0.00
6/17	3	1	1.00	0.00	0.00	0.00	0.00
6/18	1	4	0.00	0.00	1.00	0.00	0.00
6/18	2	0	0.00	0.00	0.00	0.00	0.00
6/18	3	4	0.00	0.50	0.50	0.00	0.00
6/19	1	4	0.00	0.00	1.00	0.00	0.00
6/19	3	4	0.25	0.25	0.50	0.00	0.00
6/20	1	19	0.26	0.00	0.74	0.00	0.00
6/20	2	11	0.09	0.00	0.91	0.00	0.00
6/20	3	23	0.39	0.00	0.61	0.00	0.00

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Table 5.—Page 2 of 3.

Date	Session	Catch	Proportion of Catch				
			Sockeye	Chinook	Chum	Coho	Pink
6/21	1	11	0.27	0.00	0.73	0.00	0.00
6/21	2	15	0.60	0.00	0.40	0.00	0.00
6/21	3	30	0.27	0.00	0.73	0.00	0.00
6/22	1	22	0.68	0.00	0.32	0.00	0.00
6/22	2	12	0.67	0.08	0.25	0.00	0.00
6/22	3	20	0.70	0.05	0.25	0.00	0.00
6/23	1	17	0.35	0.00	0.65	0.00	0.00
6/23	2	21	0.48	0.05	0.48	0.00	0.00
6/23	3	36	0.67	0.03	0.31	0.00	0.00
6/24	1	31	0.26	0.00	0.74	0.00	0.00
6/24	2	29	0.55	0.03	0.41	0.00	0.00
6/24	3	25	0.80	0.04	0.16	0.00	0.00
6/25	1	24	0.50	0.04	0.46	0.00	0.00
6/25	2	19	0.68	0.00	0.32	0.00	0.00
6/25	3	20	0.55	0.00	0.45	0.00	0.00
6/26	1	11	0.45	0.00	0.55	0.00	0.00
6/26	2	21	0.52	0.00	0.48	0.00	0.00
6/26	3	19	0.37	0.00	0.63	0.00	0.00
6/27	1	12	0.08	0.00	0.92	0.00	0.00
6/27	2	18	0.61	0.00	0.39	0.00	0.00
6/27	3	7	0.71	0.00	0.29	0.00	0.00
6/28	1	5	0.40	0.00	0.60	0.00	0.00
6/28	2	16	0.13	0.00	0.88	0.00	0.00
6/28	3	8	0.25	0.00	0.75	0.00	0.00
6/29	1	13	0.92	0.00	0.08	0.00	0.00
6/29	2	20	0.75	0.00	0.25	0.00	0.00
6/29	3	14	1.00	0.00	0.00	0.00	0.00
6/30	1	6	1.00	0.00	0.00	0.00	0.00
6/30	2	4	0.75	0.00	0.25	0.00	0.00
6/30	3	12	0.58	0.00	0.42	0.00	0.00
7/1	1	10	0.90	0.00	0.10	0.00	0.00
7/1	2	15	0.87	0.00	0.13	0.00	0.00
7/1	3	13	0.85	0.00	0.15	0.00	0.00
7/2	1	13	0.85	0.00	0.15	0.00	0.00
7/2	2	5	1.00	0.00	0.00	0.00	0.00
7/2	3	14	0.57	0.00	0.43	0.00	0.00
7/3	1	2	0.50	0.00	0.50	0.00	0.00
7/3	2	6	0.83	0.00	0.17	0.00	0.00
7/3	3	8	0.63	0.00	0.38	0.00	0.00
7/4	1	7	0.86	0.00	0.14	0.00	0.00
7/4	2	13	0.77	0.00	0.23	0.00	0.00
7/4	3	11	0.45	0.00	0.55	0.00	0.00
7/5	1	7	0.86	0.00	0.14	0.00	0.00
7/5	2	9	0.44	0.00	0.56	0.00	0.00
7/5	3	9	1.00	0.00	0.00	0.00	0.00

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Table 5.—Page 3 of 3.

Date	Drift Session	Catch	Proportion of Catch				
			Sockeye	Chinook	Chum	Coho	Pink
7/6	1	8	1.00	0.00	0.00	0.00	0.00
7/6	2	4	0.75	0.00	0.25	0.00	0.00
7/6	3	11	0.73	0.00	0.27	0.00	0.00
7/7	1	10	0.90	0.10	0.00	0.00	0.00
7/7	2	3	1.00	0.00	0.00	0.00	0.00
7/7	3	0	0.00	0.00	0.00	0.00	0.00
7/8	1	3	0.67	0.00	0.33	0.00	0.00
7/8	2	2	1.00	0.00	0.00	0.00	0.00
7/8	3	2	1.00	0.00	0.00	0.00	0.00
7/9	1	18	0.67	0.00	0.33	0.00	0.00
7/9	2	11	0.36	0.00	0.64	0.00	0.00
7/9	3	13	0.92	0.00	0.08	0.00	0.00
7/10	1	12	0.75	0.08	0.17	0.00	0.00
7/10	2	5	1.00	0.00	0.00	0.00	0.00
7/10	3	3	1.00	0.00	0.00	0.00	0.00
7/11	1	5	0.80	0.00	0.20	0.00	0.00
7/11	2	4	1.00	0.00	0.00	0.00	0.00
7/11	3	7	1.00	0.00	0.00	0.00	0.00
7/12	1	2	0.50	0.00	0.50	0.00	0.00
7/12	2	2	1.00	0.00	0.00	0.00	0.00
7/12	3	3	1.00	0.00	0.00	0.00	0.00
7/13	1	0	0.00	0.00	0.00	0.00	0.00
7/13	2	0	0.00	0.00	0.00	0.00	0.00
7/13	3	1	1.00	0.00	0.00	0.00	0.00
7/14	1	0	0.00	0.00	0.00	0.00	0.00
7/14	2	0	0.00	0.00	0.00	0.00	0.00
7/14	3	1	1.00	0.00	0.00	0.00	0.00
7/15	1	3	1.00	0.00	0.00	0.00	0.00
7/15	2	0	0.00	0.00	0.00	0.00	0.00
7/15	3	1	1.00	0.00	0.00	0.00	0.00
7/16	1	3	1.00	0.00	0.00	0.00	0.00
7/16	2	0	0.00	0.00	0.00	0.00	0.00
7/16	3	1	1.00	0.00	0.00	0.00	0.00
7/17	1	5	0.80	0.00	0.20	0.00	0.00
7/17	2	0	0.00	0.00	0.00	0.00	0.00
7/17	3	1	1.00	0.00	0.00	0.00	0.00
7/18	1	0	0.00	0.00	0.00	0.00	0.00
7/18	2	0	0.00	0.00	0.00	0.00	0.00
7/18	3	0	0.00	0.00	0.00	0.00	0.00

Table 6.—Right bank offshore stratum escapement sampling catch proportions by date, drift session, and salmon species, 2009.

Date	Session	Catch	Proportion of Catch				
			Sockeye	Chinook	Chum	Coho	Pink
6/6	1	0	0.00	0.00	0.00	0.00	0.00
6/6	2	0	0.00	0.00	0.00	0.00	0.00
6/6	3	0	0.00	0.00	0.00	0.00	0.00
6/7	1	0	0.00	0.00	0.00	0.00	0.00
6/7	2	0	0.00	0.00	0.00	0.00	0.00
6/7	3	1	0.00	0.00	1.00	0.00	0.00
6/8	1	2	0.00	0.00	1.00	0.00	0.00
6/8	2	0	0.00	0.00	0.00	0.00	0.00
6/8	3	0	0.00	0.00	0.00	0.00	0.00
6/9	1	0	0.00	0.00	0.00	0.00	0.00
6/9	2	0	0.00	0.00	0.00	0.00	0.00
6/9	3	1	0.00	1.00	0.00	0.00	0.00
6/10	1	0	0.00	0.00	0.00	0.00	0.00
6/10	2	0	0.00	0.00	0.00	0.00	0.00
6/10	3	0	0.00	0.00	0.00	0.00	0.00
6/11	1	4	0.00	0.00	1.00	0.00	0.00
6/11	2	0	0.00	0.00	0.00	0.00	0.00
6/11	3	0	0.00	0.00	0.00	0.00	0.00
6/12	1	0	0.00	0.00	0.00	0.00	0.00
6/12	2	0	0.00	0.00	0.00	0.00	0.00
6/12	3	0	0.00	0.00	0.00	0.00	0.00
6/13	1	0	0.00	0.00	0.00	0.00	0.00
6/13	2	0	0.00	0.00	0.00	0.00	0.00
6/13	3	1	1.00	0.00	0.00	0.00	0.00
6/14	1	0	0.00	0.00	0.00	0.00	0.00
6/14	2	0	0.00	0.00	0.00	0.00	0.00
6/14	3	0	0.00	0.00	0.00	0.00	0.00
6/15	1	3	0.00	1.00	0.00	0.00	0.00
6/15	2	0	0.00	0.00	0.00	0.00	0.00
6/15	3	4	0.00	0.75	0.25	0.00	0.00
6/16	1	1	0.00	1.00	0.00	0.00	0.00
6/16	2	0	0.00	0.00	0.00	0.00	0.00
6/16	3	0	0.00	0.00	0.00	0.00	0.00
6/17	1	3	0.33	0.00	0.67	0.00	0.00
6/17	2	0	0.00	0.00	0.00	0.00	0.00
6/17	3	1	0.00	1.00	0.00	0.00	0.00
6/18	1	0	0.00	0.00	0.00	0.00	0.00
6/18	2	0	0.00	0.00	0.00	0.00	0.00
6/18	3	3	0.00	0.33	0.67	0.00	0.00
6/19	1	1	0.00	0.00	1.00	0.00	0.00
6/19	3	6	0.33	0.17	0.50	0.00	0.00
6/20	1	2	0.00	0.00	1.00	0.00	0.00
6/20	2	6	0.17	0.50	0.33	0.00	0.00
6/20	3	6	0.00	0.00	1.00	0.00	0.00

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Table 6.—Page 2 of 3.

Date	Drift Session	Catch	Proportion of Catch				
			Sockeye	Chinook	Chum	Coho	Pink
6/21	1	6	0.17	0.33	0.50	0.00	0.00
6/21	2	4	0.25	0.50	0.25	0.00	0.00
6/21	3	11	0.09	0.00	0.91	0.00	0.00
6/22	1	7	0.14	0.00	0.86	0.00	0.00
6/22	2	6	0.83	0.00	0.17	0.00	0.00
6/22	3	7	0.00	0.71	0.29	0.00	0.00
6/23	1	4	0.25	0.00	0.75	0.00	0.00
6/23	2	8	0.25	0.25	0.50	0.00	0.00
6/23	3	10	0.00	0.20	0.80	0.00	0.00
6/24	1	9	0.00	0.11	0.89	0.00	0.00
6/24	2	10	0.00	0.20	0.80	0.00	0.00
6/24	3	11	0.36	0.45	0.18	0.00	0.00
6/25	1	5	0.20	0.00	0.80	0.00	0.00
6/25	2	10	0.20	0.30	0.50	0.00	0.00
6/25	3	17	0.12	0.06	0.82	0.00	0.00
6/26	1	3	0.67	0.00	0.33	0.00	0.00
6/26	2	9	0.11	0.11	0.78	0.00	0.00
6/26	3	9	0.33	0.11	0.56	0.00	0.00
6/27	1	5	0.60	0.00	0.40	0.00	0.00
6/27	2	6	0.33	0.17	0.50	0.00	0.00
6/27	3	8	0.50	0.13	0.38	0.00	0.00
6/28	1	5	0.60	0.20	0.20	0.00	0.00
6/28	2	5	0.20	0.20	0.60	0.00	0.00
6/28	3	8	0.13	0.13	0.75	0.00	0.00
6/29	1	6	0.50	0.17	0.33	0.00	0.00
6/29	2	4	0.75	0.00	0.25	0.00	0.00
6/29	3	5	0.40	0.00	0.60	0.00	0.00
6/30	1	5	0.60	0.20	0.20	0.00	0.00
6/30	2	4	0.25	0.25	0.50	0.00	0.00
6/30	3	4	0.25	0.25	0.50	0.00	0.00
7/1	1	1	0.00	0.00	1.00	0.00	0.00
7/1	2	2	1.00	0.00	0.00	0.00	0.00
7/1	3	1	1.00	0.00	0.00	0.00	0.00
7/2	1	3	0.67	0.33	0.00	0.00	0.00
7/2	2	1	0.00	1.00	0.00	0.00	0.00
7/2	3	4	0.25	0.25	0.50	0.00	0.00
7/3	1	2	0.50	0.00	0.50	0.00	0.00
7/3	2	3	0.00	0.00	1.00	0.00	0.00
7/3	3	3	0.33	0.67	0.00	0.00	0.00
7/4	1	5	0.40	0.20	0.40	0.00	0.00
7/4	2	4	0.50	0.00	0.50	0.00	0.00
7/4	3	7	0.43	0.29	0.29	0.00	0.00
7/5	1	4	0.25	0.00	0.75	0.00	0.00
7/5	2	5	0.40	0.00	0.60	0.00	0.00
7/5	3	10	0.40	0.00	0.60	0.00	0.00

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Table 6.–Page 3 of 3.

Date	Drift Session	Catch	Proportion of Catch				
			Sockeye	Chinook	Chum	Coho	Pink
7/6	1	11	0.64	0.00	0.36	0.00	0.00
7/6	2	5	0.40	0.20	0.40	0.00	0.00
7/6	3	0	0.00	0.00	0.00	0.00	0.00
7/7	1	3	0.67	0.33	0.00	0.00	0.00
7/7	2	5	0.20	0.00	0.80	0.00	0.00
7/7	3	10	0.20	0.00	0.80	0.00	0.00
7/8	1	5	0.60	0.00	0.40	0.00	0.00
7/8	2	2	0.00	0.50	0.50	0.00	0.00
7/8	3	2	1.00	0.00	0.00	0.00	0.00
7/9	1	5	0.40	0.20	0.40	0.00	0.00
7/9	2	3	0.33	0.00	0.67	0.00	0.00
7/9	3	1	0.00	0.00	1.00	0.00	0.00
7/10	1	2	1.00	0.00	0.00	0.00	0.00
7/10	2	5	0.20	0.20	0.60	0.00	0.00
7/10	3	6	0.83	0.00	0.17	0.00	0.00
7/11	1	3	0.33	0.00	0.67	0.00	0.00
7/11	2	2	0.50	0.00	0.50	0.00	0.00
7/11	3	6	1.00	0.00	0.00	0.00	0.00
7/12	1	1	0.00	0.00	1.00	0.00	0.00
7/12	2	4	0.75	0.00	0.25	0.00	0.00
7/12	3	2	1.00	0.00	0.00	0.00	0.00
7/13	1	2	0.50	0.50	0.00	0.00	0.00
7/13	2	0	0.00	0.00	0.00	0.00	0.00
7/13	3	1	1.00	0.00	0.00	0.00	0.00
7/14	1	4	0.50	0.00	0.50	0.00	0.00
7/14	2	0	0.00	0.00	0.00	0.00	0.00
7/14	3	0	0.00	0.00	0.00	0.00	0.00
7/15	1	4	0.75	0.00	0.25	0.00	0.00
7/15	2	0	0.00	0.00	0.00	0.00	0.00
7/15	3	0	0.00	0.00	0.00	0.00	0.00
7/16	1	0	0.00	0.00	0.00	0.00	0.00
7/16	2	0	0.00	0.00	0.00	0.00	0.00
7/16	3	2	0.00	0.00	1.00	0.00	0.00
7/17	1	1	0.00	0.00	1.00	0.00	0.00
7/17	2	0	0.00	0.00	0.00	0.00	0.00
7/17	3	7	0.14	0.00	0.86	0.00	0.00
7/18	1	0	0.00	0.00	0.00	0.00	0.00
7/18	2	0	0.00	0.00	0.00	0.00	0.00
7/18	3	0	0.00	0.00	0.00	0.00	0.00

Table 7.-Final daily and cumulative escapement estimates by salmon species, Nushagak River sonar project, 2009.

Date	Sockeye		Chinook		Chum		Total	
	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.
6/6	0	0	0	0	1,783	1,783	1,783	1,783
6/7	0	0	0	0	870	2,653	870	2,653
6/8	0	0	0	0	1,228	3,881	1,228	3,881
6/9	0	0	210	210	972	4,853	1,182	5,063
6/10	0	0	315	525	1,155	6,008	1,470	6,533
6/11	0	0	250	775	1,658	7,666	1,908	8,441
6/12	32	32	272	1,047	1,148	8,814	1,452	9,893
6/13	102	134	297	1,344	1,041	9,855	1,440	11,333
6/14	42	176	724	2,068	770	10,625	1,536	12,869
6/15	0	176	3,175	5,243	587	11,212	3,762	16,631
6/16	279	455	1,539	6,782	812	12,024	2,630	19,261
6/17	306	761	540	7,322	1,017	13,041	1,863	21,124
6/18	168	929	1,024	8,346	1,412	14,453	2,604	23,728
6/19	1,137	2,066	9,428	17,774	6,644	21,097	17,209	40,937
6/20	5,715	7,781	11,860	29,634	18,455	39,552	36,030	76,967
6/21	18,620	26,401	3,889	33,523	36,598	76,150	59,107	136,074
6/22	24,840	51,241	5,134	38,657	14,499	90,649	44,473	180,547
6/23	33,882	85,123	4,924	43,581	41,186	131,835	79,992	260,539
6/24	38,920	124,043	4,354	47,935	44,754	176,589	88,028	348,567
6/25	34,706	158,749	2,058	49,993	36,196	212,785	72,960	421,527
6/26	15,191	173,940	1,703	51,696	27,134	239,919	44,028	465,555
6/27	10,676	184,616	1,750	53,446	18,786	258,705	31,212	496,767
6/28	4,987	189,603	2,069	55,515	16,386	275,091	23,442	520,209
6/29	21,248	210,851	2,998	58,513	9,744	284,835	33,990	554,199
6/30	28,696	239,547	3,698	62,211	13,409	298,244	45,803	600,002
7/1	32,357	271,904	2,153	64,364	10,315	308,559	44,825	644,827
7/2	18,175	290,079	2,074	66,438	10,660	319,219	30,909	675,736
7/3	6,724	296,803	1,046	67,484	7,148	326,367	14,918	690,654
7/4	16,963	313,766	3,505	70,989	13,216	339,583	33,684	724,338
7/5	28,118	341,884	3,148	74,137	15,756	355,339	47,022	771,360
7/6	13,021	354,905	2,290	76,427	10,976	366,315	26,287	797,647

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Table 7.—Page 2 of 2.

Date	Sockeye		Chinook		Chum		Total	
	Daily	Cum.	Daily	Cum.	Daily	Cum.	Daily	Cum.
7/7	18,397	373,302	1,230	77,657	16,282	382,597	35,909	833,556
7/8	19,754	393,056	749	78,406	10,799	393,396	31,302	864,858
7/9	29,019	422,075	293	78,699	18,761	412,157	48,073	912,931
7/10	19,328	441,403	291	78,990	4,741	416,898	24,360	937,291
7/11	9,603	451,006	696	79,686	2,691	419,589	12,990	950,281
7/12	7,012	458,018	230	79,916	3,516	423,105	10,758	961,039
7/13	7,880	465,898	198	80,114	2,183	425,288	10,261	971,300
7/14	6,328	472,226	425	80,539	2,631	427,919	9,384	980,684
7/15	5,066	477,292	305	80,844	2,705	430,624	8,076	988,760
7/16	2,062	479,354	521	81,365	1,953	432,577	4,536	993,296
7/17	2,893	482,247	82	81,447	3,672	436,249	6,647	999,943
7/18	1,902	484,149	33	81,480	2,232	438,481	4,167	1,004,110
Total	484,149		81,480		438,481		1,004,110	

Note: 455 coho salmon not represented.

Table 8.—Total escapement estimates by strata and species, Nushagak River sonar project, 2009.

Strata	Left Bank			Right Bank			Total
	Inshore	Offshore	LB Total	Inshore	Offshore	RB Total	
Total Fish	419,885	169,947	589,832	330,015	84,718	414,733	1,004,565
Total Var	153,636,330	54,790,216	208,426,546	119,379,470	14,171,662	133,551,132	341,977,678
SE	12,395	7,402	14,437	10,926	3,765	11,556	18,493
CV(E)	0.030	0.044	0.024	0.033	0.044	0.028	0.018
Sockeye salmon	242,012	17,407	259,419	193,881	30,849	224,730	484,149
Total Var	84,132,245	7,683,327	91,815,572	66,087,791	5,560,032	71,647,823	163,463,395
SE	9,172	2,772	9,582	8,129	2,358	8,465	12,785
CV(E)	0.038	0.159	0.037	0.042	0.076	0.038	0.026
Chinook salmon	11,180	56,769	67,949	3,365	10,166	13,531	81,480
Total Var	5,231,188	20,087,059	25,318,247	1,558,654	2,148,523	3,707,177	29,025,424
SE	2,287	4,482	5,032	1,248	1,466	1,925	5,388
CV(E)	0.205	0.079	0.074	0.371	0.144	0.142	0.066
chum salmon	166,693	95,316	262,009	132,769	43,703	176,472	438,481
Total Var	64,272,898	26,890,208	91,163,106	51,733,025	6,463,107	58,196,131	149,359,237
SE	8,017	5,186	9,548	7,193	2,542	7,629	12,221
CV(E)	0.048	0.054	0.036	0.054	0.058	0.043	0.028

Table 9.—Sockeye salmon escapement estimates and average escapement percentage by date, Nushagak River, 2000–2009.

Date	Year										Daily Average
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
06/04	—	—	—	—	—	—	—	0	—	—	0
06/05	—	—	—	—	—	—	—	0	—	—	0
06/06	—	—	—	—	—	—	—	0	—	0	0
06/07	—	—	—	65	—	—	—	0	—	0	22
06/08	—	—	0	290	0	824	0	0	—	0	159
06/09	—	—	0	443	0	175	0	0	55	0	84
06/10	73	—	0	376	0	196	199	0	54	0	100
06/11	46	—	0	280	0	173	235	0	18	0	84
06/12	67	230	0	0	1,186	192	0	35	24	32	177
06/13	245	173	221	0	821	449	0	24	58	102	209
06/14	86	3,253	0	0	145	365	0	16	25	42	393
06/15	54	3,819	0	98	195	1,568	0	37	37	0	581
06/16	261	1,031	47	106	402	1,793	200	132	123	279	437
06/17	386	247	3	3,541	2,499	1,133	64	463	285	306	893
06/18	140	194	269	7,598	4,120	20,819	311	1,571	383	168	3,557
06/19	453	819	1,530	4,119	9,550	42,794	264	747	669	1,137	6,208
06/20	724	5,772	8,598	3,443	29,527	16,596	153	449	66	5,715	7,104
06/21	405	8,768	6,099	9,853	17,754	44,412	261	1,104	80	18,620	10,736
06/22	264	14,214	6,998	41,818	6,146	25,074	4,226	5,857	269	24,840	12,971
06/23	124	34,970	6,149	78,962	8,452	23,209	9,321	51,189	4,070	33,882	25,033
06/24	94	29,123	8,488	41,316	36,530	68,594	8,879	20,526	3,719	38,920	25,619
06/25	1,968	38,804	4,840	52,701	29,831	45,588	41,885	30,225	12,504	34,706	29,305
06/26	16,742	44,456	4,097	42,533	14,901	19,184	62,776	33,790	28,247	15,191	28,192
06/27	4,247	28,083	15,018	27,905	12,704	14,404	102,798	25,725	58,781	10,676	30,034
06/28	45,905	10,449	32,821	34,842	7,114	6,398	42,421	14,651	51,110	4,987	25,070
06/29	70,221	6,527	20,799	18,552	25,240	10,547	19,830	21,443	16,208	21,248	23,062
06/30	46,978	22,989	42,265	14,068	37,925	30,292	11,320	15,292	6,296	28,696	25,612

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Table 9.—Page 2 of 3.

Date	Year										Daily Average
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
07/01	30,858	50,353	14,095	19,014	45,691	229,756	19,042	16,808	14,957	32,357	47,293
07/02	13,997	39,027	16,136	18,946	18,282	159,361	20,561	16,029	25,114	18,175	34,563
07/03	13,110	85,925	4,484	49,433	9,060	50,767	17,382	17,035	42,357	6,724	29,628
07/04	15,431	127,463	6,760	42,629	12,969	21,655	16,982	18,029	37,161	16,963	31,604
07/05	6,656	60,521	5,315	14,427	25,240	12,677	10,898	25,391	21,767	28,118	21,101
07/06	4,479	32,314	7,548	6,225	23,859	14,083	15,433	44,623	15,383	13,021	17,697
07/07	2,530	30,063	9,636	3,706	37,439	26,381	13,560	33,245	14,941	18,397	18,990
07/08	2,535	11,410	10,991	6,045	21,749	42,390	21,961	19,878	13,691	19,754	17,040
07/09	3,630	15,791	22,223	3,974	5,448	24,660	27,059	14,314	14,147	29,019	16,026
07/10	5,121	17,238	14,826	2,357	4,788	23,344	13,955	13,916	20,657	19,328	13,553
07/11	2,581	8,273	9,110	6,919	3,247	23,364	9,662	10,518	14,086	9,603	9,736
07/12	5,086	6,604	5,593	3,375	1,273	13,953	9,418	8,141	14,984	7,012	7,544
07/13	41,229	4,814	4,584	6,364	3,575	7,624	6,440	13,757	13,602	7,880	10,987
07/14	27,279	6,326	4,029	3,522	8,385	7,214	9,745	10,295	16,366	6,328	9,949
07/15	4,694	7,171	3,955	3,501	4,643	4,482	12,003	9,181	8,157	5,066	6,285
07/16	4,880	8,297	3,631	2,505	2,923	2,915	10,362	6,238	8,766	2,062	5,258
07/17	3,903	5,340	4,255	1,078	3,074	10,213	8,802	7,373	8,571	2,893	5,550
07/18	3,771	7,388	464	1,214	1,124	—	—	6,815	4,758	1,902	3,429
07/19	2,562	7,647	658	1,499	729	—	—	3,179	—	—	2,712
07/20	2,157	4,081	1,016	891	1,218	—	—	—	—	—	1,873
07/21	2,294	3,126	1,383	—	998	—	—	—	—	—	1,950
07/22	1,812	6,315	1,097	—	1,183	—	—	—	—	—	2,602
07/23	1,986	979	845	—	1,430	—	—	—	—	—	1,310
07/24	2,332	784	714	—	1,188	—	—	—	—	—	1,254
07/25	1,421	165	1,183	—	0	—	—	—	—	—	692
07/26	238	179	334	—	0	—	—	—	—	—	188
07/27	291	144	0	—	0	—	—	—	—	—	109
07/28	1,202	83	0	—	879	—	—	—	—	—	541
07/29	1,027	34	0	—	809	—	—	—	—	—	468
07/30	827	51	1,842	—	0	—	—	—	—	—	680
07/31	183	201	331	—	78	—	—	—	—	—	198

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Table 9.—Page 3 of 3.

Date	Year										Daily Average
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
08/01	1,035	236	278	—	3,036	—	—	—	—	—	1,146
08/02	1,071	63	123	—	1,391	—	—	—	—	—	662
08/03	1,031	51	0	—	0	—	—	—	—	—	271
08/04	769	35	0	—	0	—	—	—	—	—	201
08/05	9	34	0	—	32	—	—	—	—	—	19
08/06	—	26	0	—	91	—	—	—	—	—	39
08/07	—	25	0	—	0	—	—	—	—	—	8
08/08	—	29	0	—	856	—	—	—	—	—	295
08/09	—	190	0	—	0	—	—	—	—	—	63
08/10	—	104	0	—	0	—	—	—	—	—	35
08/11	—	94	0	—	0	—	—	—	—	—	31
08/12	—	104	0	—	0	—	—	—	—	—	35
08/13	—	217	0	—	0	—	—	—	—	—	72
08/14	—	135	0	—	0	—	—	—	—	—	45
08/15	—	43	0	—	0	—	—	—	—	—	14
08/16	—	28	0	—	0	—	—	—	—	—	9
08/17	—	16	0	—	—	—	—	—	—	—	8
08/18	—	17	—	—	—	—	—	—	—	—	17
08/19	—	46	—	—	—	—	—	—	—	—	46
08/20	—	16	—	—	—	—	—	—	—	—	16
Total	403,500	803,537	315,681	580,534	491,730	1,049,620	548,410	518,041	492,546	484,149	568,775

Table 10.—Estimated daily passage by species, bank, and strata, Nushagak River, 2009.

Date	Sockeye				Chinook				Chum			
	Left Bank		Right Bank		Left Bank		Right Bank		Left Bank		Right Bank	
	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore
6/6	0	0	0	0	0	0	0	0	441	418	636	288
6/7	0	0	0	0	0	0	0	0	342	156	318	54
6/8	0	0	0	0	0	0	0	0	438	136	552	102
6/9	0	0	0	0	183	0	0	27	273	438	180	81
6/10	0	0	0	0	103	168	0	44	359	378	288	130
6/11	0	0	0	0	0	209	0	41	660	313	438	247
6/12	32	0	0	0	0	225	0	47	286	225	426	211
6/13	57	0	0	45	0	297	0	0	285	111	510	135
6/14	0	0	0	42	192	532	0	0	144	266	234	126
6/15	0	0	0	0	29	2,232	116	798	307	0	280	0
6/16	77	0	202	0	0	1,165	0	374	306	0	506	0
6/17	63	0	178	65	21	373	59	87	126	140	621	130
6/18	64	0	0	104	14	706	165	139	42	212	741	417
6/19	397	0	386	354	44	9,009	257	118	2,247	1,935	1,931	531
6/20	3,365	0	2,011	339	696	10,481	0	683	5,695	5,845	4,883	2,032
6/21	12,173	1,685	4,359	403	1,329	2,208	0	352	18,766	5,054	10,899	1,879
6/22	14,579	409	9,161	691	1,647	2,692	416	379	7,498	1,226	4,739	1,036
6/23	17,982	0	15,390	510	1,768	2,002	713	441	20,162	3,086	15,390	2,548
6/24	19,765	605	17,999	551	542	2,188	658	966	21,412	2,722	17,499	3,121
6/25	18,353	1,059	14,718	576	884	485	408	281	13,523	3,970	16,056	2,647
6/26	5,978	515	7,874	824	1,040	448	0	215	11,558	2,061	11,374	2,141
6/27	5,180	0	4,223	1,273	0	1,563	0	187	9,562	1,053	7,039	1,132
6/28	2,140	0	2,200	647	464	1,352	0	253	5,232	1,558	8,432	1,164
6/29	6,371	0	13,645	1,232	198	2,700	0	100	6,067	414	2,339	924
6/30	14,559	278	12,623	1,236	848	1,554	0	1,296	6,066	2,500	3,607	1,236
7/1	14,713	1,628	14,585	1,431	0	1,441	0	712	4,013	2,714	2,515	1,073
7/2	8,918	483	7,891	883	204	1,283	0	587	4,920	2,896	2,255	589
7/3	1,794	723	3,848	359	170	638	0	238	2,819	1,687	1,924	718

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Table 10.–Page 2 of 2.

Date	Sockeye				Chinook				Chum			
	Left Bank		Right Bank		Left Bank		Right Bank		Left Bank		Right Bank	
	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore	Inshore	Offshore
7/4	6,625	1,846	6,928	1,564	200	2,860	0	445	3,915	4,924	3,260	1,117
7/5	17,843	1,010	7,662	1,603	489	2,659	0	0	2,974	7,071	3,192	2,519
7/6	5,311	1,829	3,949	1,932	0	2,129	0	161	2,897	5,943	929	1,207
7/7	6,636	2,796	7,967	998	0	621	443	166	1,422	12,117	0	2,743
7/8	10,981	1,123	5,774	1,876	0	499	0	250	2,615	5,614	1,444	1,126
7/9	21,000	0	6,702	1,317	0	0	0	293	4,200	8,406	3,960	2,195
7/10	13,683	635	3,314	1,696	0	0	130	161	1,053	2,329	390	969
7/11	4,350	783	2,902	1,568	0	696	0	0	1,740	261	242	448
7/12	1,916	0	3,235	1,861	0	230	0	0	766	862	647	1,241
7/13	2,798	0	4,170	912	0	76	0	122	700	284	834	365
7/14	1,543	0	3,564	1,221	0	222	0	203	257	1,170	594	610
7/15	1,392	0	2,418	1,256	0	305	0	0	348	1,603	0	754
7/16	336	0	678	1,048	0	521	0	0	84	1,171	0	698
7/17	742	0	1,895	256	82	0	0	0	124	1,379	379	1,790
7/18	296	0	1,430	176	33	0	0	0	49	668	286	1,229
Total	242,012	17,407	193,881	30,849	11,180	56,769	3,365	10,166	166,693	95,316	132,769	43,703

Table 11.—Chinook salmon escapement estimates and average escapement percentage by date, Nushagak River, 2000–2009.

Date	Year										Daily Average
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
06/04	—	—	—	—	—	—	—	5	—	—	5
06/05	—	—	—	—	—	—	—	353	—	—	353
06/06	—	—	—	—	—	—	—	144	125	—	134
06/07	—	—	—	193	—	—	—	273	93	—	186
06/08	—	—	1,179	1,032	660	4,712	947	373	131	—	1,291
06/09	—	—	7,957	1,773	1,119	1,336	3,873	393	452	210	2,139
06/10	309	—	4,774	2,304	1,266	1,712	7,128	496	518	315	2,091
06/11	171	—	993	1,205	1,066	981	5,688	862	301	250	1,280
06/12	197	561	643	531	3,024	1,379	2,847	502	404	272	1,036
06/13	872	559	267	446	4,863	1,381	1,260	407	284	297	1,063
06/14	292	7,303	262	366	2,494	1,263	589	530	231	724	1,405
06/15	273	9,319	273	1,811	881	3,323	479	787	147	3,175	2,047
06/16	1,107	2,905	626	1,529	957	987	215	539	1,757	1,539	1,216
06/17	2,791	568	637	2,377	2,543	1,015	479	1,286	2,136	540	1,437
06/18	938	399	221	4,291	3,516	41,155	2,049	2,713	1,028	1,024	5,733
06/19	1,895	1,230	4,668	2,773	20,395	19,033	1,145	424	285	9,428	6,128
06/20	2,855	1,830	15,187	2,994	10,629	8,609	457	249	391	11,860	5,506
06/21	1,419	3,305	2,773	2,049	3,004	7,465	292	65	244	3,889	2,451
06/22	928	4,247	1,919	2,749	2,127	10,242	3,940	3,154	1,521	5,134	3,596
06/23	546	6,584	4,762	2,244	5,192	9,188	4,040	8,943	1,709	4,924	4,813
06/24	428	4,736	3,681	3,671	11,428	5,817	3,527	2,422	6,811	4,354	4,688
06/25	7,699	4,522	3,247	4,866	2,208	3,766	9,803	990	3,932	2,058	4,309
06/26	5,441	4,943	1,304	6,053	1,304	3,588	6,285	1,906	16,030	1,703	4,856
06/27	1,098	3,738	1,385	4,328	2,536	2,143	6,365	1,084	10,808	1,750	3,523
06/28	2,412	1,772	492	3,170	724	2,249	4,849	4,402	2,512	2,069	2,465
06/29	2,291	1,113	1,982	2,794	1,734	3,961	3,066	3,559	2,177	2,998	2,568
06/30	2,451	3,242	1,835	1,758	3,653	4,278	4,595	3,073	3,248	3,698	3,183

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Table 11.–Page 2 of 3.

Date	Year										Daily Average
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
07/01	3,354	3,784	1,281	1,883	4,584	4,900	8,044	2,336	1,372	2,153	3,369
07/02	1,560	1,718	2,111	4,029	2,778	4,334	4,921	1,839	2,939	2,074	2,830
07/03	1,767	2,213	1,549	2,264	1,820	3,461	5,279	1,050	4,719	1,046	2,517
07/04	2,162	2,883	685	2,293	1,164	2,707	3,668	1,248	2,583	3,505	2,290
07/05	874	1,225	1,303	1,136	2,824	2,322	3,076	780	1,230	3,148	1,792
07/06	820	821	2,146	1,060	1,978	2,078	2,654	1,569	3,078	2,290	1,849
07/07	610	945	1,921	1,082	3,839	2,329	1,569	1,720	2,790	1,230	1,803
07/08	535	904	2,068	679	1,359	727	3,504	68	1,142	749	1,174
07/09	414	929	784	400	639	166	3,899	791	2,271	293	1,059
07/10	414	1,125	1,398	1,641	240	876	1,702	422	1,961	291	1,007
07/11	238	651	676	1,009	515	4,782	2,652	385	1,591	696	1,320
07/12	334	525	692	1,270	557	1,214	1,715	1,005	2,081	230	962
07/13	951	367	569	254	312	769	2,198	1,107	3,788	198	1,051
07/14	1,252	446	940	220	506	1,021	2,130	1,146	1,325	425	941
07/15	391	1,005	688	377	602	241	1,662	592	2,289	305	815
07/16	408	1,309	467	1,375	162	425	1,138	411	2,650	521	887
07/17	291	990	444	479	159	772	953	2,079	1,557	82	781
07/18	297	1,048	785	457	160	–	–	1,362	689	33	604
07/19	308	1,015	462	534	243	–	–	615	–	–	529
07/20	203	592	391	279	183	–	–	–	–	–	330
07/21	181	421	426	–	592	–	–	–	–	–	405
07/22	181	743	363	–	412	–	–	–	–	–	425
07/23	111	462	220	–	179	–	–	–	–	–	243
07/24	87	342	349	–	284	–	–	–	–	–	265
07/25	68	162	154	–	57	–	–	–	–	–	110
07/26	33	162	355	–	0	–	–	–	–	–	138
07/27	55	134	62	–	174	–	–	–	–	–	106
07/28	198	85	578	–	26	–	–	–	–	–	222
07/29	466	60	300	–	659	–	–	–	–	–	371
07/30	72	57	59	–	1,809	–	–	–	–	–	499
07/31	136	215	274	–	0	–	–	–	–	–	156

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Table 11.–Page 3 of 3.

Date	Year										Daily Average
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
08/01	339	199	34	–	0	–	–	–	–	–	143
08/02	370	56	124	–	8	–	–	–	–	–	139
08/03	323	57	324	–	8	–	–	–	–	–	178
08/04	156	36	290	–	5	–	–	–	–	–	122
08/05	0	42	504	–	6	–	–	–	–	–	138
08/06	–	39	0	–	0	–	–	–	–	–	13
08/07	–	30	13	–	198	–	–	–	–	–	81
08/08	–	45	122	–	0	–	–	–	–	–	56
08/09	–	260	103	–	14	–	–	–	–	–	126
08/10	–	117	60	–	23	–	–	–	–	–	67
08/11	–	94	0	–	0	–	–	–	–	–	31
08/12	–	435	0	–	0	–	–	–	–	–	145
08/13	–	293	0	–	0	–	–	–	–	–	98
08/14	–	133	0	–	0	–	–	–	–	–	44
08/15	–	52	0	–	0	–	–	–	–	–	17
08/16	–	31	0	–	0	–	–	–	–	–	10
08/17	–	30	0	–	–	–	–	–	–	–	15
08/18	–	29	–	–	–	–	–	–	–	–	29
08/19	–	42	–	–	–	–	–	–	–	–	42
08/20	–	41	–	–	–	–	–	–	–	–	41
Total	56,372	92,275	87,141	80,028	116,400	172,708	124,683	60,458	97,330	81,480	96,888

Table 12.—Chum salmon escapement estimates and average escapement percentage by date, Nushagak River, 2000–2009.

Date	Year										Daily Average
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
06/04	—	—	—	—	—	—	—	1	—	—	1
06/05	—	—	—	—	—	—	—	96	—	—	96
06/06	—	—	—	—	—	—	—	61	109	1,783	651
06/07	—	—	—	22	—	—	—	68	99	870	265
06/08	—	—	3,953	257	0	824	2,204	96	91	1,228	1,082
06/09	—	—	23,653	427	0	87	3,789	105	375	972	3,676
06/10	529	—	29,067	375	0	196	12,977	140	592	1,155	5,003
06/11	410	—	9,472	338	0	520	18,762	631	246	1,658	3,560
06/12	552	1,065	4,133	49	1,099	461	11,870	336	387	1,148	2,110
06/13	1,743	928	3,500	19	2,109	57	3,972	304	444	1,041	1,412
06/14	665	14,597	2,297	199	450	729	4,697	369	332	770	2,510
06/15	369	17,824	2,199	34	1,011	3,465	3,720	111	332	587	2,965
06/16	2,236	5,249	941	19	1,630	168	3,450	168	616	812	1,529
06/17	4,290	1,137	757	3,151	10,674	1,617	1,946	288	2,325	1,017	2,720
06/18	1,117	872	1,749	5,600	5,334	77,821	29,019	1,810	2,069	1,412	12,680
06/19	3,804	3,290	25,505	5,190	24,978	25,709	14,648	2,293	294	6,644	11,236
06/20	6,188	8,841	39,254	4,222	46,225	9,688	4,165	1,070	1,499	18,455	13,961
06/21	3,382	14,457	6,047	11,584	16,835	25,570	19,906	281	2,922	36,598	13,758
06/22	2,326	20,765	4,945	22,038	14,700	30,341	35,805	4,790	9,958	14,499	16,017
06/23	1,054	36,113	23,275	9,438	15,504	26,537	40,878	28,257	20,417	41,186	24,266
06/24	889	28,633	27,489	10,139	16,626	22,605	17,186	15,847	19,955	44,754	20,412
06/25	15,690	29,192	7,190	26,322	6,699	14,381	59,927	8,646	17,589	36,196	22,183
06/26	14,334	32,744	5,278	2,345	4,997	17,919	44,735	12,807	49,257	27,134	21,155
06/27	3,637	12,037	31,537	11,819	12,510	13,598	85,437	5,258	33,058	18,786	22,768
06/28	11,077	4,762	16,033	14,918	6,655	7,052	36,610	10,329	27,679	16,386	15,150
06/29	17,056	2,991	10,109	7,894	2,109	4,125	18,622	10,761	5,105	9,744	8,852
06/30	18,172	10,062	11,425	8,495	14,556	18,634	25,451	7,773	3,236	13,409	13,121

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Table 12.–Page 2 of 3.

Date	Year										Daily Average
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
07/01	4,925	15,712	20,870	11,916	12,777	19,414	28,610	3,559	13,113	10,315	14,121
07/02	2,261	7,876	6,360	20,842	4,025	19,906	29,379	2,728	26,440	10,660	13,048
07/03	2,180	19,047	10,603	13,141	599	7,487	35,158	2,692	8,357	7,148	10,641
07/04	2,445	28,512	4,164	7,008	3,344	13,101	14,938	866	7,128	13,216	9,472
07/05	948	26,953	6,631	9,967	2,954	5,754	10,500	1,878	2,177	15,756	8,352
07/06	693	14,630	3,718	6,898	8,132	7,408	6,779	3,862	7,190	10,976	7,029
07/07	430	14,176	5,104	18,579	5,374	11,699	2,453	2,975	14,807	16,282	9,188
07/08	415	12,882	3,715	12,354	4,080	6,005	3,683	1,957	2,429	10,799	5,832
07/09	524	18,939	2,048	4,379	2,901	4,552	4,511	2,038	3,725	18,761	6,238
07/10	677	19,411	5,257	6,592	547	14,945	1,106	4,154	4,538	4,741	6,197
07/11	314	9,898	2,752	5,067	253	17,879	4,636	3,122	2,047	2,691	4,866
07/12	627	7,687	3,561	4,982	317	9,426	2,836	1,812	413	3,516	3,518
07/13	3,505	5,841	5,112	4,570	512	1,089	2,620	3,194	4,587	2,183	3,321
07/14	3,875	8,119	9,838	3,045	2,385	474	2,518	1,526	3,802	2,631	3,821
07/15	687	9,892	4,468	3,309	2,195	1,834	4,741	836	5,917	2,705	3,658
07/16	705	11,582	3,365	3,142	625	3,675	3,651	3,361	9,189	1,953	4,125
07/17	626	8,079	5,868	3,834	2,757	9,271	3,110	3,489	7,486	3,672	4,819
07/18	616	10,033	4,859	2,870	1,956	–	–	3,256	3,969	2,232	3,724
07/19	449	9,551	1,566	4,392	754	–	–	1,482	–	–	3,032
07/20	359	5,057	1,203	3,628	507	–	–	–	–	–	2,151
07/21	374	3,850	4,260	–	153	–	–	–	–	–	2,159
07/22	283	7,193	2,986	–	153	–	–	–	–	–	2,654
07/23	301	4,995	1,937	–	104	–	–	–	–	–	1,834
07/24	343	3,779	636	–	2,824	–	–	–	–	–	1,896
07/25	221	1,181	1,098	–	3,547	–	–	–	–	–	1,512
07/26	79	1,242	969	–	2,253	–	–	–	–	–	1,136
07/27	95	1,008	2,546	–	262	–	–	–	–	–	978
07/28	403	597	1,870	–	1,902	–	–	–	–	–	1,193
07/29	359	245	1,133	–	1,904	–	–	–	–	–	910
07/30	269	349	1,523	–	0	–	–	–	–	–	535
07/31	177	1,440	15	–	78	–	–	–	–	–	428

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Table 12.–Page 3 of 3.

Date	Year										Daily Average
	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	
08/01	336	1,608	78	–	740	–	–	–	–	–	690
08/02	353	442	43	–	3,264	–	–	–	–	–	1,026
08/03	328	347	–	–	78	–	–	–	–	–	251
08/04	433	246	–	–	84	–	–	–	–	–	254
08/05	89	249	–	–	1,624	–	–	–	–	–	654
08/06	16	199	–	–	8	–	–	–	–	–	74
08/07	12	201	–	–	2,970	–	–	–	–	–	1,061
08/08	9	244	–	–	14	–	–	–	–	–	89
08/09	6	1,494	–	–	150	–	–	–	–	–	550
08/10	8	858	–	–	0	–	–	–	–	–	289
08/11	6	738	–	–	0	–	–	–	–	–	248
08/12	7	1,209	–	–	0	–	–	–	–	–	405
08/13	12	2,032	–	–	0	–	–	–	–	–	681
08/14	8	1,139	–	–	0	–	–	–	–	–	382
08/15	5	399	–	–	0	–	–	–	–	–	135
08/16	5	253	–	–	0	–	–	–	–	–	86
08/17	6	186	–	–	–	–	–	–	–	–	96
08/18	–	182	–	–	–	–	–	–	–	–	182
08/19	–	388	–	–	–	–	–	–	–	–	388
08/20	–	266	–	–	–	–	–	–	–	–	266
Total	141,324	547,995	419,964	295,413	283,811	456,024	661,002	161,482	326,300	438,481	373,180

Table 13.—Age composition of sockeye salmon escapement, Nushagak River, 2009.

Sampling Period	Date		Age Group							Total
	Start	End	0.3	1.2	0.4	1.3	2.2	1.4	2.3	
Period 1:	06 Jun	28 Jun								
Percent (%)			3.6	15.6	0.2	67.2	0.6	12.2	0.6	100.0
SE (%)			0.9	1.7		2.2	0.4	1.5	0.4	2.0
Number of Fish			6,873	29,512	404	127,345	1,213	23,043	1,213	189,603
SE (Number)			1,638	3,177		4,116	699	2,864	699	3,748
Sample Size			17	73	1	315	3	57	3	469
Period 2:	29 Jun	18 Jul								
Percent (%)			1.5	37.2	0.6	51.3	0.4	8.0	1.0	100.0
SE (%)			0.5	2.1	0.3	2.2	0.3	1.2	0.4	2.1
Number of Fish			4,497	109,612	1,686	151,208	1,124	23,609	2,811	294,546
SE (Number)			1,579	6,226	972	6,437	794	3,497	1,252	6,061
Sample Size			8	195	3	269	2	42	5	524
Total	06 Jun	18 Jul								
Percent (%)			2.3	28.7	0.4	57.5	0.5	9.6	0.8	100.0
SE (%)			0.8	2.0	0.3	2.2	0.3	1.4	0.4	2.0
Number of Fish			11,369	139,123	2,091	278,553	2,337	46,652	4,023	484,149
SE (Number)			1,615	5,717	873	5,499	746	3,200	1,115	5,278
Sample Size			25	268	4	584	5	99	8	993

Table 14.—Sex composition by age and mean length (mm) by age, and sex of sockeye salmon escapement, Nushagak River, 2009.

Sampling Period	Date		Age Group							Total
	Start	End	0.3	1.2	0.4	1.3	2.2	1.4	2.3	
Period 1: Both Sexes	06 Jun	28 Jun								
Number			6,873	29,512	404	127,345	1,213	23,043	1,213	189,603
SE (Number)			1,638	3,177		4,116	699	2,864	699	3,748
Percent (%)			3.6	15.6	0.2	67.2	0.6	12.2	0.6	100.0
SE (%)			0.9	1.7		2.2	0.4	1.5	0.4	2.0
n (Number)			17	73	1	315	3	57	3	469
Mean Length			599	540	600	586	548	609	633	582
SE (Length)			7.6	5.4		2.1		5.5	1.7	1.8
n (Length)			17	73	1	314	3	57	3	468
Males										
Number			4,043	21,022		57,589	809	8,894	809	93,165
SE (Males)			1,298	2,762		4,039	659	1,872	659	3,496
Males (%)			58.8	71.2		45.2	66.7	38.6	66.7	49.1
SE (%Males)			12.3	5.3		2.8	33.3	6.5	33.3	6.4
n (Males)			10	52		142	2	22	2	230
Mean Length (Males)			617	546		606	530	639	648	596
SE (Length-Males)			9.7	6.9		3.8		10.1	2.5	3.0
n (Length-Males)			10	52		142	2	22	2	230
Females										
Number			2,830	8,490	404	69,756	404	14,149	404	96,438
SE (Females)			1,100	1,828		4,235	521	2,318	521	3,754
Females (%)			41.2	28.8	100.0	54.8	33.3	61.4	33.3	50.9
SE (%Females)			12.3	5.3		2.8	33.3	6.5	33.3	5.3
n (Females)			7	21	1	172	1	35	1	238
Mean Length (Females)			573	527	600	569	585	590	605	569
SE (Length-Females)			12.0	7.9		2.2		6.3		2.0
n (Length-Females)			7	21	1	172	1	35	1	238

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Table 14.–Page 2 of 3.

Sampling Period	Date		Age Group							Total
	Start	End	0.3	1.2	0.4	1.3	2.2	1.4	2.3	
Period 2:	29 Jun	18 Jul								
Both Sexes	Number		4,497	109,612	1,686	151,208	1,124	23,609	2,811	294,546
	SE (Number)		1,579	6,226	972	6,437	794	3,497	1,252	6,061
	Percent (%)		1.5	37.2	0.6	51.3	0.4	8.0	1.0	100.0
	SE (%)		0.5	2.1	0.3	2.2	0.3	1.2	0.4	2.1
	n (Number)		8	195	3	269	2	42	5	524
	Mean Length		570	508	612	576	465	601	561	552
	SE (Length)		19.4	3.0	18.6	1.5		6.0	8.2	1.5
	n (Length)		8	195	3	269	2	42	5	524
Males	Number		2,811	47,217		84,879	562	14,615	1,686	151,770
	SE (Males)		1,317	4,736		5,840	795	2,822	1,064	5,183
	Males (%)		62.5	43.1		56.1	50.0	61.9	60.0	51.5
	SE (%Males)		18.3	3.6		3.0	50.0	7.6	24.5	6.1
	n (Males)		5	84		151	1	26	3	270
	Mean Length (Males)		575	524		592	435	614	572	572
	SE (Length-Males)		30.9	5.5		2.2		7.8	9.3	2.3
	n (Length-Males)		5	84		151	1	26	3	270
Females	Number		1,686	62,394	1,686	66,329	562	8,994	1,124	142,776
	SE (Females)		1,054	5,272	972	5,387	795	2,247	905	5,097
	Females (%)		37.5	56.9	100.0	43.9	50.0	38.1	40.0	48.5
	SE (%Females)		18.3	3.6		3.0	50.0	7.6	24.5	5.7
	n (Females)		3	111	3	118	1	16	2	254
	Mean Length (Females)		562	496	612	556	495	580	545	532
	SE (Length-Females)		4.4	3.2	18.6	2.1		9.4	15.0	1.8
	n (Length-Females)		3	111	3	118	1	16	2	254

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Table 14.–Page 3 of 3.

Sampling Period	Date		Age Group							Total
	Start	End	0.3	1.2	0.4	1.3	2.2	1.4	2.3	
Total	06 Jun	18 Jul								
Both Sexes	Number		11,369	139,123	2,091	278,553	2,337	46,652	4,023	484,149
	SE (Number)		1,615	5,717	891	5,499	746	3,200	1,115	5,278
	Percent (%)		2.3	28.7	0.4	57.5	0.5	9.6	0.8	100.0
	SE (%)		0.8	2.0	0.3	2.2	0.3	1.4	0.4	2.0
	n (Number)		25	268	4	584	5	99	8	993
	Mean Length		587	515	609	581	508	605	583	564
	SE (Length)		8.4	2.6	14.4	1.3		4.0	5.4	1.1
	n (Length)		25	268	4	583	5	99	8	992
	Number		6,853	68,239		142,468	1,371	23,509	2,495	244,935
	SE (Males)		1,306	4,227		5,188	718	2,505	952	4,615
Males	Males (%)		60.3	49.0		51.1	58.6	50.4	62.0	50.6
	SE (%Males)		15.1	4.2		2.9	41.0	7.2	27.7	6.2
	n (Males)		15	136		293	3	48	5	500
	Mean Length (Males)		599	531		598	491	623	596	581
	SE (Length-Males)		12.9	4.3		2.1		6.2	6.0	1.8
	n (Length-Males)		15	136		293	3	48	5	500
	Number		4,516	70,884	2,091	136,085	966	23,143	1,528	239,214
	SE (Females)		1,083	4,987	891	4,831	694	2,291	821	4,603
	Females (%)		39.7	51.0	100.0	48.9	41.4	49.6	38.0	49.4
	SE (%Females)		14.8	3.8		2.9	43.8	6.9	27.1	5.5
Females	n (Females)		10	132	4	290	2	51	3	492
	Mean Length (Females)		569	500	609	563	533	586	561	547
	SE (Length-Females)		8.1	3.0	14.4	1.5		5.2	10.5	1.3
	n (Length-Females)		10	132	4	290	2	51	3	492

Note: SE = Standard Error, n = Sample Size.

Table 15.—Age composition of Chinook salmon escapement, Nushagak River, 2009.

Sampling Period	Date		Age Group				
	Start	End	1.1	1.2	1.3	1.4	Total
Total	06 Jun	18 Jul					
Percent (%)			0.4	29.6	33.9	36.1	100.0
SE (%)				3.0	3.1	3.2	3.1
Number of Fish			354	24,090	27,632	29,404	81,480
SE (Number)				2,457	2,549	2,586	2,530
Sample Size			1	68	78	83	230

Table 16.—Sex composition by age and mean length (mm) by age, and sex of Chinook salmon escapement, Nushagak River, 2009.

Sampling Period	Date		Age Group				
	Start	End	1.1	1.2	1.3	1.4	Total
Period 1:	06 Jun	18 Jul					
Both Sexes	Number		354	24,090	27,632	29,404	81,480
	SE (Number)			2,457	2,549	2,586	2,530
	Percent (%)		0.4	29.6	33.9	36.1	100.0
	SE (%)			3.0	3.1	3.2	3.1
	n (Number)		1	68	78	83	230
	Mean Length		440	585	759	843	737
	SE (Length)			8.8	8.5	7.8	4.8
	n (Length)		1	68	75	80	224
Males	Number		354	17,359	16,149	8,247	42,109
	SE (Males)			2,213	2,163	1,642	2,084
	Males (%)		100.0	72.1	58.4	28.0	51.7
	SE (% Males)			5.5	5.7	5.0	5.4
	n (Males)		1	49	45	23	118
	Mean Length (Males)		440	576	745	837	690
	SE (Length-Males)			9.2	11.2	19.3	6.9
	n (Length-Males)		1	49	45	22	117
Females	Number			6,731	11,484	21,156	39,371
	SE (Females)			1,494	1,893	2,373	2,110
	Females (%)			27.9	41.6	72.0	48.3
	SE (% Females)			5.5	5.7	5.0	5.3
	n (Females)			19	32	59	110
	Mean Length (Females)			611	780	846	786
	SE (Length-Females)			20.8	13.0	7.8	6.7
	n (Length-Females)			19	30	58	107

Note: SE = Standard Error, n = Sample Size.

Table 17.—Age composition of chum salmon escapement, Nushagak River, 2009.

Sampling Period	Date		Age Group			Total
	Start	End	0.2	0.3	0.4	
Total	06 Jun	18 Jul				
Percent (%)			0.3	55.7	44.0	100.0
SE (%)				2.6	2.6	2.6
Number of Fish			1,198	244,399	192,884	438,481
SE (Number)				11,400	11,392	11,381
Sample Size			1	204	161	366

Table 18.—Sex composition by age and mean length (mm) by age and sex of chum salmon escapement, Nushagak River, 2009.

Sampling Period	Date		Age Group			Total
	Start	End	0.2	0.3	0.4	
Period 1:	06 Jun	18 Jul				
Both Sexes	Number		1,198	244,399	192,884	438,481
	SE (Number)			11,400	11,392	11,381
	Percent (%)		0.3	55.7	44.0	100.0
	SE (%)			2.6	2.6	2.6
	n (Number)		1	204	161	366
	Mean Length		595	620	634	626
	SE (Length)			2.8	3.4	2.1
	n (Length)		1	204	161	366
Males	Number		1,198	123,398	118,606	243,201
	SE (Males)			10,336	10,214	10,252
	Males (%)		100.0	50.5	61.5	55.5
	SE (% Males)			3.5	3.8	3.7
	n (Males)		1	103	99	203
	Mean Length (Males)		595	635	651	643
	SE (Length-Males)			4.2	4.6	3.1
	n (Length-Males)		1	103	99	203
Females	Number			121,002	74,278	195,280
	SE (Females)			10,275	8,631	9,682
	Females (%)			49.5	38.5	44.5
	SE (% Females)			3.5	3.8	3.6
	n (Females)			101	62	163
	Mean Length (Females)			604	605	604
	SE (Length-Females)			3.6	4.7	2.8
	n (Length-Females)			101	62	163

Note: SE = Standard Error, n = Sample Size.

Table 19.—Average air and water temperature, Nushagak River sonar project, June, July and August, 2009.

Year	Average Air Temperature (°C)			Average Water Temperature (°C)		
	June	July	August	June	July	August
1989	11.5	14.0	14.8	10.4	14.9	15.6
1990	12.1	13.7	12.3	11.7	14.8	14.1
1991	12.1	14.1	13.1	11.6	14.7	14.3
1992	12.3	12.8	^a	10.7	11.7	^a
1993	11.7	14.0	11.9	12.5	15.4	14.3
1994	11.3	11.8	11.7	12.8	12.8	14.6
1995	12.3	13.3	11.0	10.5	14.5	13.0
1996	11.2	12.8	11.5	12.0	14.3	13.2
1997	13.6	15.0	12.5	14.3	16.6	14.6
1998	10.7	12.9	11.4	9.1	13.2	13.2
1999	11.6	14.1	11.3	11.1	13.6	13.1
2000	11.9	12.7	13.0	11.2	13.7	13.3
2001	11.0	10.8	12.1	11.2	13.7	13.3
2002	13.0	13.3	14.6	11.7	14.2	15.8
2003	11.4	13.5	^a	13.0	14.2	^a
2004	13.3	15.5	16.7	12.7	15.9	16.3
2005	15.9	15.5	^a	13.1	15.9	^a
2006	14.5	18.2	^a	10.7	14.4	^a
2007	13.6	14.8	^a	13.6	13.2	^a
2008	10.5	11.7	^a	11.4	14.3	^a
2009	11.4	16.6	^a	11.3	16.3	^a
1989-08 Min	10.5	10.8	11.0	9.1	11.7	13.0
1989-08 Max	15.9	18.2	16.7	14.3	16.6	16.3
1989-08 Average	12.3	13.7	12.7	11.8	14.3	14.2

^a Project not operated in August.



Figure 1.—Nushagak River sonar site, Bristol Bay.

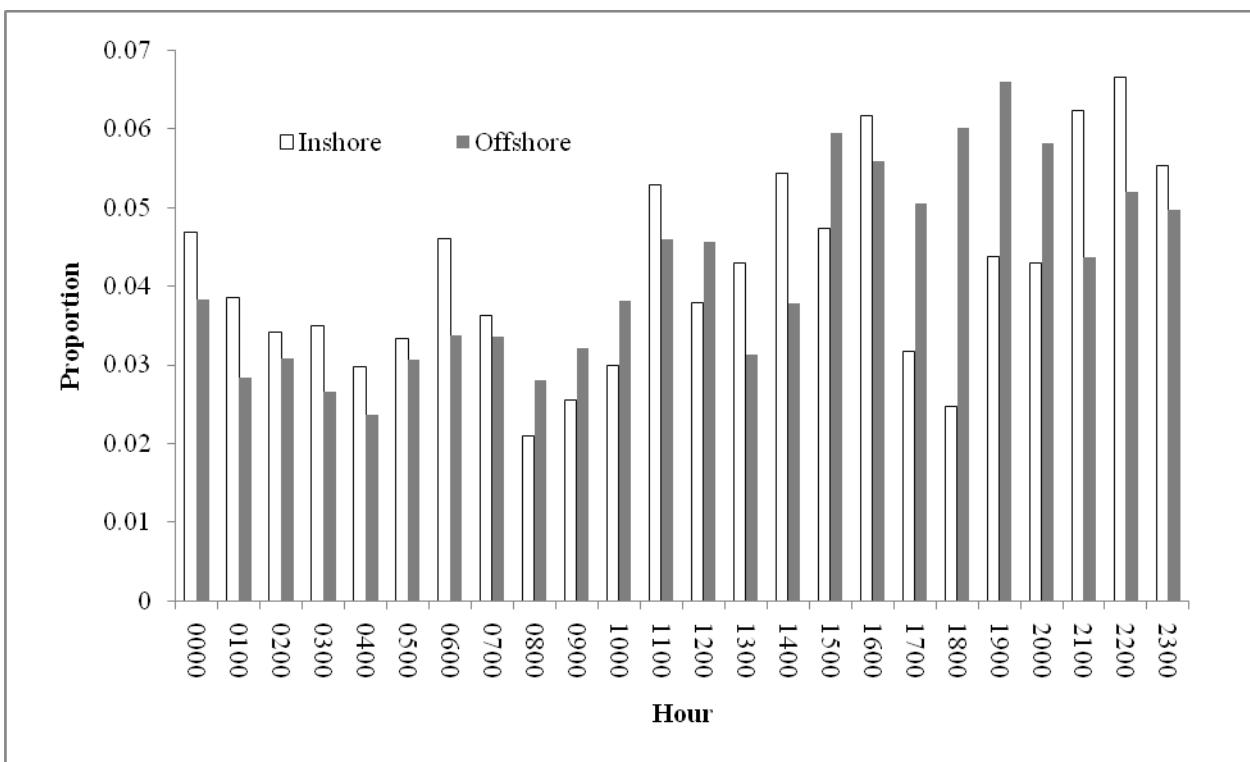


Figure 2.—Average proportion of total sonar counts by hour for the left bank inshore and offshore strata, Nushagak River, 2009.

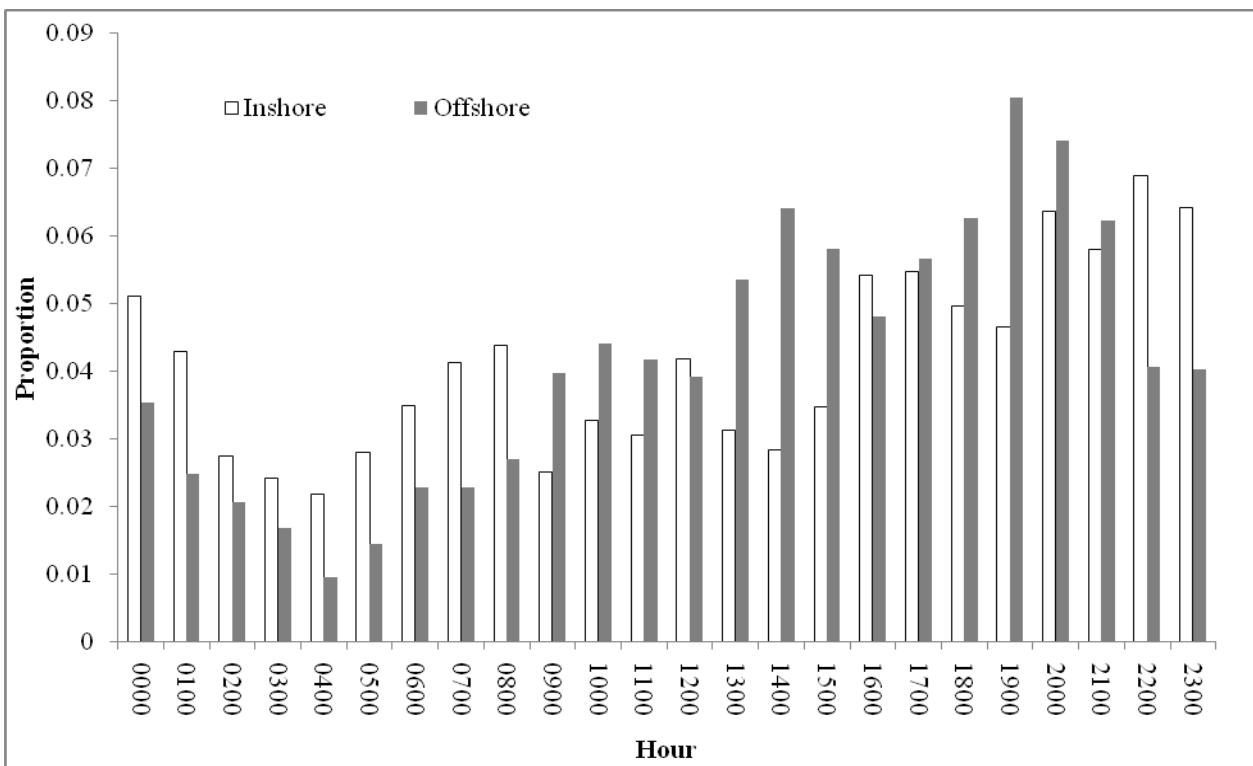


Figure 3.—Average proportion of total sonar counts by hour for the right bank inshore and offshore strata, Nushagak River, 2009.

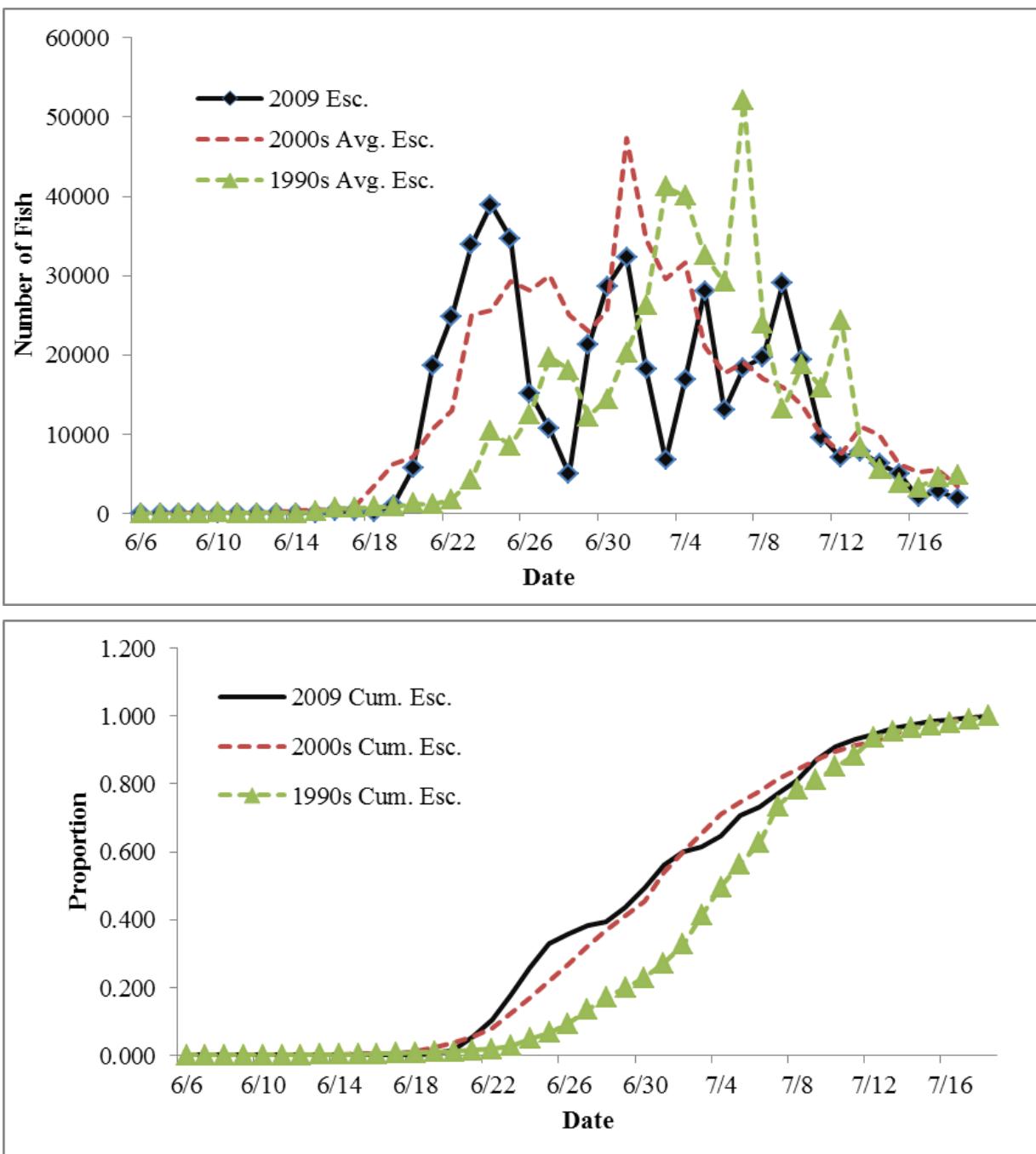


Figure 4.—Average daily (top) and cumulative escapement (bottom) timing for sockeye salmon, Nushagak River, 2009.

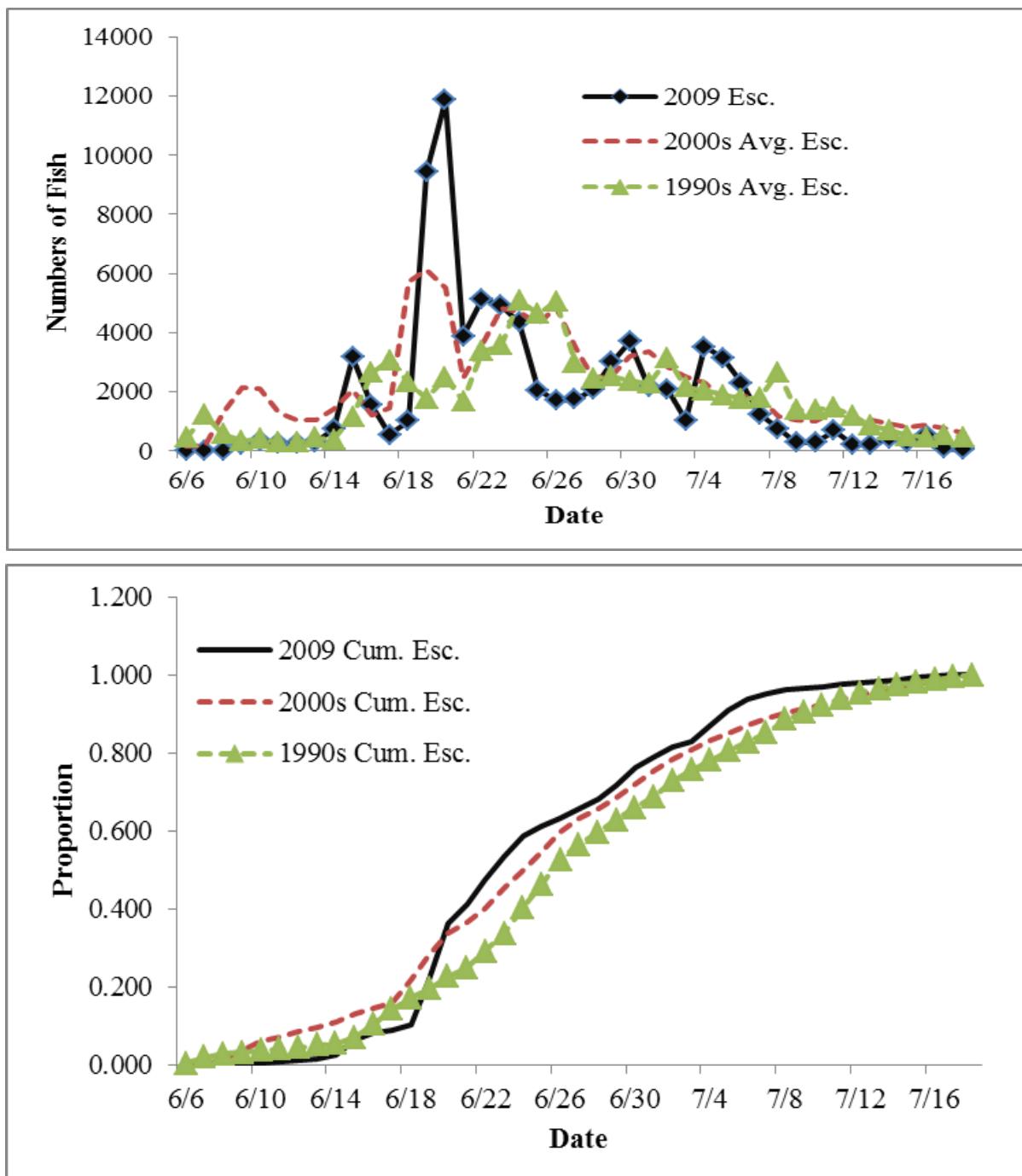


Figure 5.—Average daily (top) and cumulative escapement (bottom) timing for Chinook salmon, Nushagak River, 2009.

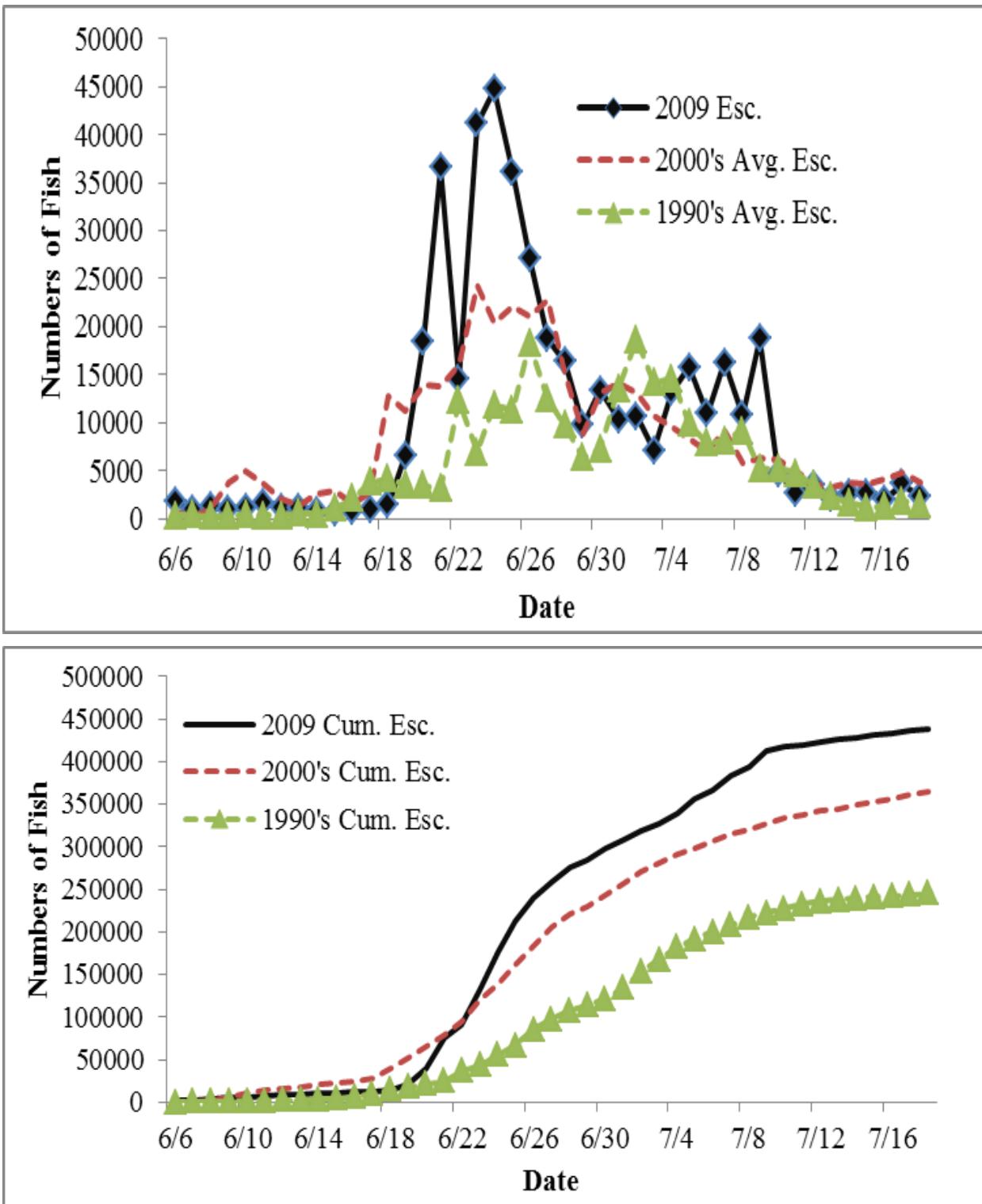


Figure 6.—Average daily (top) and cumulative escapement (bottom) timing for chum salmon, Nushagak River, 2009.

APPENDIX A: SONAR HOURLY COUNTS

Appendix A1.—Sonar hourly counts by date, left bank inshore stratum, Nushagak River sonar project, 2009.

Date	Hour											
	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100
6/6	0	60	6	30	30	60	24	60	12	18	0	15
6/7	0	18	48	6	6	36	18	12	24	0	6	24
6/8	0	12	12	42	6	42	12	18	24	90	18	24
6/9	48	18	54	12	12	18	42	0	66	0	12	19
6/10	24	42	24	24	30	24	30	72	6	12	-6	0
6/11	24	42	24	30	30	36	36	114	12	6	0	24
6/12	12	24	18	12	6	-6	18	6	36	36	6	30
6/13	18	30	12	24	12	18	18	6	24	18	24	24
6/14	0	6	12	18	36	18	36	12	12	-6	0	24
6/15	30	12	12	12	0	-6	0	-6	42	18	0	12
6/16	6	48	18	6	6	42	18	42	6	0	0	6
6/17	0	0	6	6	24	18	-24	24	0	0	0	6
6/18	0	6	12	12	0	12	6	0	0	-6	0	6
6/19	0	18	12	78	42	30	72	102	156	0	18	0
6/20	24	270	90	276	60	444	714	480	42	36	282	90
6/21	720	408	414	654	162	162	1,848	1,860	1,548	210	1,062	534
6/22	1,602	636	270	186	114	414	1,176	414	6	1,878	828	1,320
6/23	1,134	516	306	108	90	240	516	1,146	180	84	108	2,094
6/24	3,342	1,176	1,086	468	234	1,578	2,730	2,214	1,266	3,954	1,902	1,080
6/25	1,104	588	462	222	108	1,062	1,332	648	282	528	1,044	3,204
6/26	378	234	492	396	354	510	1,194	408	342	486	3,294	1,614
6/27	912	1,008	414	216	162	228	498	216	96	684	1,338	2,814
6/28	366	522	294	186	114	138	414	126	6	0	156	1,632
6/29	288	384	282	84	108	294	432	318	240	210	210	1,554
6/30	720	648	780	402	534	612	462	288	-6	402	582	1,356

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Date	Hour											
	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
6/6	15	15	24	6	0	0	6	12	0	18	12	18
6/7	24	18	6	12	0	6	6	12	18	0	36	6
6/8	24	24	30	12	0	0	6	6	12	0	18	6
6/9	19	19	12	19	19	19	0	18	0	12	12	6
6/10	0	24	24	6	42	-6	24	12	24	24	0	6
6/11	96	30	6	6	12	12	36	0	12	30	30	12
6/12	0	42	18	30	12	0	6	6	6	-12	12	0
6/13	12	36	0	18	0	24	0	0	30	0	-6	0
6/14	60	24	66	12	0	0	12	0	0	0	-6	0
6/15	24	24	48	12	6	0	6	24	6	48	-6	18
6/16	-6	30	24	54	0	12	13	13	13	13	13	6
6/17	0	30	0	6	0	0	12	60	0	6	30	6
6/18	0	0	6	12	0	12	6	12	0	12	12	0
6/19	12	12	54	60	138	18	6	438	594	426	270	132
6/20	6	30	0	240	600	402	66	216	486	1,728	2,052	1,122
6/21	924	600	126	324	1,236	1,656	2,352	2,232	444	4,518	4,032	4,242
6/22	2,454	1,116	432	288	912	1,092	30	216	2,304	2,472	2,100	1,464
6/23	924	1,686	1,614	2,022	1,800	456	1,692	5,286	804	5,994	6,114	4,998
6/24	1,086	1,284	2,916	1,614	3,072	132	828	2,778	2,334	762	2,358	1,524
6/25	804	2,178	3,900	1,146	3,090	1,914	660	1,230	3,792	1,788	828	846
6/26	1,062	228	1,206	1,332	954	588	438	144	534	624	1,068	696
6/27	954	1,254	840	1,116	618	270	0	24	342	168	108	462
6/28	108	24	612	480	816	306	552	378	240	36	222	108
6/29	582	288	2,034	1,512	1,308	306	96	378	600	204	306	618
6/30	1,482	3,306	3,306	1,872	960	996	912	510	360	162	144	684

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Date	Hour											
	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100
7/1	516	504	510	570	954	1,026	1,824	828	192	252	390	2,064
7/2	456	912	654	1,056	450	384	450	1,080	876	18	78	840
7/3	414	636	294	558	672	174	114	144	108	24	0	54
7/4	90	132	252	168	84	90	96	36	6	240	408	300
7/5	1,458	2,202	1,218	1,866	1,254	990	390	294	108	228	216	228
7/6	1,368	678	1,566	1,452	1,332	810	288	288	60	0	-6	48
7/7	324	534	516	654	726	282	354	120	54	6	54	282
7/8	240	816	1,176	1,122	750	576	570	432	348	-6	114	84
7/9	846	864	840	1,314	1,062	750	888	786	984	66	78	252
7/10	1,818	1,086	1,200	1,320	1,620	1,422	924	804	18	60	234	120
7/11	708	624	540	360	792	678	732	648	264	72	-6	18
7/12	336	126	144	420	252	384	270	72	0	126	6	72
7/13	42	54	30	138	126	288	546	846	1,020	318	12	6
7/14	126	30	48	24	54	72	126	42	126	342	96	6
7/15	72	132	84	72	48	54	6	150	90	198	0	234
7/16	-12	72	48	6	12	12	96	6	0	84	6	6
7/17	18	24	12	36	-6	0	18	96	6	12	0	6
7/18	72	12	30	12	0	6	-6	6	96	6	12	48

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Date	Hour											
	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
7/1	42	1,596	822	1,506	1,368	660	300	120	1,074	330	636	642
7/2	1,638	1,136	924	1,068	654	330	108	6	162	372	192	198
7/3	18	78	18	564	348	96	48	0	234	36	144	6
7/4	1,908	1,572	612	384	912	78	54	384	144	606	1,428	756
7/5	30	18	810	768	786	1,122	1,026	1,854	732	1,506	1,290	912
7/6	30	0	12	6	6	12	-6	0	6	36	60	162
7/7	78	90	210	456	486	102	174	60	186	1,086	942	282
7/8	120	6	366	684	696	336	78	894	912	1,146	1,128	1,008
7/9	648	408	918	2,088	3,678	2,172	756	432	1,296	1,620	1,050	1,404
7/10	144	246	258	78	972	144	108	414	174	360	870	342
7/11	6	18	96	0	132	0	0	54	24	6	102	222
7/12	0	174	0	0	72	0	0	6	0	0	192	30
7/13	12	6	0	12	30	0	-6	18	6	6	-12	0
7/14	-18	24	126	6	120	12	-6	120	114	0	150	60
7/15	252	228	42	42	0	0	6	-6	-6	0	0	42
7/16	42	0	0	-6	6	12	-6	0	0	0	6	30
7/17	186	96	276	6	0	0	0	0	6	0	12	144
7/18	84	0	0	0	0	0	0	0	0	0	0	0

Appendix A2.—Sonar hourly counts by date, left bank offshore stratum, Nushagak River sonar project, 2009.

Date	Hour											
	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100
6/6	6	30	6	30	24	42	78	24	36	18	12	13
6/7	12	0	6	6	6	-6	0	6	12	0	6	12
6/8	0	0	0	12	6	18	6	-6	12	6	24	8
6/9	0	6	12	0	12	0	42	12	18	6	30	18
6/10	84	48	30	12	24	30	30	0	36	12	60	30
6/11	84	48	30	12	24	30	30	0	60	18	0	18
6/12	42	6	18	18	18	54	30	42	60	-12	12	-6
6/13	24	36	18	36	0	18	84	18	6	0	12	6
6/14	18	0	12	0	6	30	6	18	18	30	42	66
6/15	30	42	42	42	6	78	48	48	84	54	66	78
6/16	36	24	36	66	48	102	78	30	12	66	66	12
6/17	6	18	54	42	18	6	12	0	36	33	12	84
6/18	6	24	18	6	18	6	6	-6	6	0	6	0
6/19	108	234	192	258	456	336	414	366	480	300	528	558
6/20	294	318	330	348	162	588	258	1,158	354	696	792	540
6/21	1,020	660	486	216	174	540	378	492	516	378	510	198
6/22	180	120	90	96	48	102	132	126	48	144	120	54
6/23	156	144	72	36	0	60	126	174	210	48	234	114
6/24	528	186	168	144	126	162	186	252	510	366	108	306
6/25	180	138	138	84	72	108	216	162	282	708	372	342
6/26	90	30	108	96	120	144	204	174	132	306	414	168
6/27	150	192	126	66	72	150	192	114	96	42	366	210
6/28	30	48	126	72	96	102	114	90	138	78	96	564
6/29	96	102	54	36	30	36	108	84	54	108	222	162
6/30	54	90	258	168	150	24	324	102	84	66	192	120

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Date	Hour											
	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
6/6	13	13	0	6	6	0	7	12	12	6	18	6
6/7	6	6	6	0	6	18	12	6	12	6	6	12
6/8	6	8	6	0	0	12	0	6	0	0	0	12
6/9	18	18	18	18	18	18	18	24	60	18	42	12
6/10	12	30	12	18	6	18	0	0	18	18	18	0
6/11	12	0	24	12	24	24	24	18	18	0	-6	18
6/12	66	12	18	6	6	12	0	24	6	18	0	0
6/13	48	0	12	18	6	6	30	6	6	6	6	6
6/14	36	66	36	60	90	36	18	6	0	12	84	108
6/15	162	138	318	348	24	84	150	78	54	54	132	72
6/16	90	150	66	72	6	18	35	35	35	35	35	12
6/17	6	24	-48	12	78	6	6	30	6	54	6	12
6/18	30	0	18	12	72	54	12	198	210	60	108	54
6/19	486	510	246	420	360	534	1,224	414	390	648	936	546
6/20	432	258	366	564	1,122	516	384	1,866	228	372	2,850	1,530
6/21	462	96	114	84	156	264	126	114	462	342	504	654
6/22	858	126	36	126	450	114	102	300	318	240	156	240
6/23	78	192	414	114	24	216	264	174	474	432	714	618
6/24	270	126	234	174	96	96	438	192	54	510	156	126
6/25	174	414	30	750	162	168	372	174	192	102	114	60
6/26	198	18	108	54	54	42	60	66	156	156	90	36
6/27	126	18	78	54	48	78	162	42	96	78	42	18
6/28	288	54	414	108	162	84	30	48	150	0	12	6
6/29	240	468	138	276	36	306	144	30	66	162	108	48
6/30	180	144	180	246	168	204	366	390	264	192	114	252

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Date	Hour											
	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100
7/1	102	168	174	204	54	54	66	228	210	204	228	462
7/2	198	36	54	420	114	78	180	78	198	36	168	198
7/3	60	138	114	108	354	48	-6	48	0	96	126	36
7/4	54	54	240	42	210	90	30	132	42	132	180	432
7/5	384	450	264	240	174	360	138	72	102	234	198	684
7/6	660	360	660	144	492	636	966	180	96	30	36	156
7/7	786	282	318	204	372	474	732	558	96	30	18	444
7/8	678	468	408	624	192	378	216	348	120	522	42	114
7/9	36	102	132	360	84	30	60	48	48	84	420	462
7/10	114	72	132	114	66	174	42	54	24	114	36	24
7/11	12	12	24	36	12	6	-6	48	30	60	258	174
7/12	-6	6	96	6	-12	6	60	30	42	84	48	60
7/13	-30	18	6	48	12	18	12	72	54	18	0	18
7/14	36	-12	6	0	24	12	12	0	18	102	42	30
7/15	36	42	84	18	108	18	96	138	150	18	204	228
7/16	-6	0	60	-6	36	48	66	60	18	24	108	78
7/17	42	42	0	0	18	6	-18	156	96	126	6	354
7/18	126	30	30	42	6	6	0	-12	132	78	60	174

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Date	Hour											
	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
7/1	150	168	114	234	462	330	678	588	582	96	108	120
7/2	120	72	270	522	144	102	300	534	384	174	132	150
7/3	234	36	216	288	168	114	24	174	240	204	42	186
7/4	216	384	402	1,092	414	450	528	1,038	1,560	774	384	750
7/5	258	528	456	1,200	768	588	270	816	750	618	354	834
7/6	462	120	18	600	666	336	468	522	738	582	480	492
7/7	858	336	1,182	1,272	966	1,848	1,308	1,164	804	324	354	804
7/8	168	30	60	72	408	198	870	528	150	396	78	168
7/9	60	132	96	426	1,296	714	1,182	1,050	882	492	66	144
7/10	42	36	90	366	384	516	222	180	48	18	54	42
7/11	36	156	54	66	168	180	60	18	144	54	66	72
7/12	-12	24	12	114	102	78	108	120	24	42	30	30
7/13	-12	54	36	-6	36	0	24	6	-12	-12	-6	6
7/14	36	12	126	18	30	12	54	66	312	108	258	90
7/15	150	42	282	54	72	18	0	132	-6	-12	0	36
7/16	312	144	132	156	120	78	108	18	6	36	48	48
7/17	228	144	24	72	102	84	36	-6	6	18	132	18
7/18	144	0	0	0	0	0	0	0	0	0	0	0

Appendix A3.—Sonar hourly counts by date, right bank inshore stratum, Nushagak River sonar project, 2009.

Date	Hour											
	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100
6/6	48	18	6	12	0	6	18	48	30	12	60	72
6/7	0	12	18	6	30	24	0	42	0	6	12	54
6/8	24	0	36	12	6	18	24	18	12	60	42	54
6/9	6	0	24	6	6	18	0	0	6	6	18	0
6/10	24	18	36	30	12	12	6	6	18	36	0	12
6/11	0	78	12	30	6	36	6	24	48	6	42	0
6/12	12	48	30	18	48	0	-6	30	12	6	0	36
6/13	18	84	84	24	24	48	24	24	12	12	0	0
6/14	-6	-12	0	0	42	36	-6	6	0	24	12	24
6/15	18	48	12	18	0	6	0	0	72	0	6	6
6/16	66	126	30	48	0	24	0	60	0	0	24	0
6/17	42	6	36	18	12	90	6	12	42	54	18	6
6/18	66	24	48	18	-12	114	54	6	174	-12	18	54
6/19	24	30	54	42	-6	66	102	18	-6	48	6	18
6/20	294	354	126	102	54	258	78	264	108	30	24	168
6/21	756	618	204	228	450	348	624	816	198	120	0	450
6/22	1,908	888	750	258	282	258	828	822	234	138	474	390
6/23	444	324	306	96	180	312	564	438	390	936	462	222
6/24	1,626	2,484	1,086	852	282	672	954	906	1,470	132	3,618	294
6/25	1,608	918	702	684	540	450	1,488	1,524	1,458	552	396	780
6/26	1,266	1,596	1,278	630	282	684	510	954	450	1,356	1,110	126
6/27	1,056	450	432	486	330	360	672	246	270	54	198	468
6/28	1,332	684	234	222	276	234	288	216	312	84	264	1,446
6/29	696	648	216	150	174	372	114	294	948	708	168	96
6/30	960	1,416	786	486	420	684	642	486	312	522	114	828

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Date	Hour											
	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
6/6	66	36	6	36	42	18	6	36	24	0	30	6
6/7	24	18	6	0	0	12	0	12	6	0	18	18
6/8	24	30	12	6	48	12	6	48	0	6	24	30
6/9	6	0	6	24	0	6	12	24	6	0	0	6
6/10	0	0	0	18	6	12	12	12	18	0	0	0
6/11	6	18	0	18	6	6	0	12	0	42	42	0
6/12	30	6	18	18	18	18	12	0	18	18	36	0
6/13	0	24	36	18	12	6	24	0	6	18	6	6
6/14	18	0	18	36	6	0	6	6	0	0	0	24
6/15	18	0	6	18	6	6	30	0	30	0	54	42
6/16	6	6	48	6	54	72	30	18	18	42	24	6
6/17	42	6	72	42	36	12	6	54	72	36	72	66
6/18	24	0	0	0	108	36	48	24	78	0	24	12
6/19	156	66	114	6	120	72	228	246	378	342	192	258
6/20	150	36	78	300	246	246	864	372	648	900	558	636
6/21	1,074	324	342	102	234	330	174	2,004	852	744	1,584	2,682
6/22	552	240	900	102	114	330	900	1,020	576	570	846	936
6/23	1,272	1,014	234	480	978	3,846	2,310	2,232	6,678	1,890	3,120	2,766
6/24	552	2,550	2,652	732	972	618	2,586	1,074	2,238	2,604	3,246	1,956
6/25	1,314	30	1,086	3,888	1,440	2,550	2,328	2,322	654	1,968	1,524	978
6/26	816	450	282	60	1,680	750	162	912	546	744	834	1,770
6/27	642	174	300	372	474	804	786	588	348	234	402	1,116
6/28	450	918	66	90	930	504	174	78	276	372	450	732
6/29	1,770	510	150	648	2,418	1,110	660	150	690	1,236	1,254	804
6/30	180	246	156	930	1,518	858	348	48	654	738	1,386	1,512

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Appendix A3.–Page 3 of 4.

Date	Hour											
	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100
7/1	1,068	876	654	894	906	402	558	480	480	150	252	438
7/2	762	198	228	612	600	252	318	1,140	678	72	168	18
7/3	282	426	54	192	240	606	108	240	486	450	108	108
7/4	318	144	138	90	150	228	486	222	438	6	84	750
7/5	834	402	324	342	210	240	714	144	1,068	426	90	240
7/6	108	420	144	210	276	372	138	684	144	426	156	168
7/7	138	198	308	308	308	308	308	894	162	258	498	186
7/8	360	276	108	138	144	102	186	216	1,158	318	390	402
7/9	108	48	108	174	174	114	42	258	1,290	96	762	642
7/10	96	108	144	84	168	294	30	84	342	624	54	42
7/11	90	48	18	18	180	120	432	492	132	114	534	18
7/12	24	12	18	72	72	138	114	258	546	18	378	312
7/13	150	72	66	36	144	126	252	528	78	-18	186	438
7/14	54	78	78	72	78	138	12	192	114	84	6	504
7/15	168	6	54	90	66	78	192	132	288	42	0	12
7/16	0	-12	0	84	66	120	18	0	48	0	18	0
7/17	-6	24	0	42	-6	162	294	138	24	204	-6	6
7/18	0	0	54	24	6	282	312	288	414	90	60	186

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Appendix A3.–Page 4 of 4.

Date	Hour											
	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
7/1	774	792	1,248	462	684	486	630	726	1,572	840	834	894
7/2	696	144	138	300	846	390	498	426	504	546	372	240
7/3	252	252	126	144	246	330	564	30	78	114	270	66
7/4	570	216	72	522	306	546	414	690	492	918	1,044	1,344
7/5	126	216	126	120	582	858	402	126	954	1,278	654	378
7/6	6	90	30	30	132	150	18	66	234	276	426	174
7/7	246	90	144	114	144	126	516	102	900	486	1,020	648
7/8	120	36	42	36	294	408	318	534	336	402	756	138
7/9	258	72	36	750	1,848	888	774	564	48	576	798	234
7/10	126	18	42	42	288	234	6	390	90	324	162	42
7/11	84	12	0	30	114	216	6	42	120	150	84	90
7/12	96	78	18	6	198	492	96	180	252	150	192	162
7/13	228	138	306	174	414	648	126	120	486	210	36	60
7/14	834	648	114	228	36	90	276	42	-12	102	186	204
7/15	0	168	186	288	102	6	30	36	12	174	198	90
7/16	0	12	6	54	108	-6	6	0	96	0	12	48
7/17	192	618	108	198	108	-12	-6	12	42	84	12	42
7/18	0	0	0	0	0	0	0	0	0	0	0	0

Appendix A4.—Sonar hourly counts by date, right bank offshore stratum, Nushagak River sonar project, 2009.

Date	Hour											
	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100
6/6	0	18	6	6	0	24	12	6	12	24	30	6
6/7	-6	0	6	0	0	0	18	0	0	6	0	0
6/8	0	0	0	0	0	0	12	12	0	0	-6	0
6/9	0	0	0	0	0	0	0	6	12	6	12	0
6/10	6	30	12	0	12	12	0	6	0	0	0	0
6/11	18	6	0	12	0	12	6	0	0	0	0	12
6/12	18	0	6	18	0	0	0	18	0	24	0	30
6/13	6	36	18	12	6	6	24	0	0	6	12	0
6/14	6	0	0	0	0	0	0	0	-6	0	0	0
6/15	0	6	6	0	24	6	12	0	24	0	66	18
6/16	126	12	18	18	0	24	0	30	30	20	12	6
6/17	0	6	36	0	6	6	0	30	0	12	12	12
6/18	6	0	0	12	0	0	12	6	6	24	12	30
6/19	48	42	0	6	6	6	6	30	6	12	6	6
6/20	138	96	72	36	0	12	6	12	54	0	156	102
6/21	18	72	6	18	0	24	36	6	54	84	174	150
6/22	270	84	36	24	0	18	36	30	0	54	144	240
6/23	12	36	6	6	6	24	60	24	18	60	0	60
6/24	36	42	66	-24	12	18	132	84	36	114	1,218	54
6/25	78	36	18	36	18	36	24	30	96	156	42	36
6/26	252	162	108	72	18	120	108	60	30	120	36	72
6/27	72	36	48	18	-6	18	18	24	42	78	54	222
6/28	270	48	36	108	6	48	48	54	72	48	72	156
6/29	192	36	24	-18	0	6	54	18	36	78	54	72
6/30	132	132	132	60	18	18	18	42	60	150	210	216

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Appendix A4.–Page 2 of 4.

Date	Hour											
	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
6/6	6	0	36	12	12	12	6	12	18	12	12	6
6/7	0	0	6	12	0	0	12	0	0	0	0	0
6/8	0	0	0	30	30	0	0	0	6	12	0	6
6/9	0	12	0	12	0	12	18	12	0	6	0	0
6/10	12	0	0	6	24	12	18	0	12	6	0	6
6/11	0	30	0	36	18	60	24	36	18	0	0	0
6/12	6	12	12	6	12	12	18	6	6	18	18	18
6/13	0	0	0	24	0	0	-6	12	6	6	18	-6
6/14	0	0	0	30	18	12	30	24	12	6	30	6
6/15	12	30	18	36	78	60	60	30	144	60	30	78
6/16	0	12	18	6	6	0	18	0	0	6	6	6
6/17	12	24	42	24	0	0	12	18	0	-6	18	18
6/18	0	0	24	0	84	114	102	42	12	48	48	78
6/19	6	180	0	6	30	12	126	372	42	6	12	36
6/20	12	-6	42	36	66	36	336	126	1,164	366	114	78
6/21	36	24	192	84	60	30	96	516	186	324	318	126
6/22	0	144	108	0	48	60	108	30	108	330	186	48
6/23	18	126	252	24	96	222	270	756	582	546	114	180
6/24	12	252	258	120	42	66	228	948	384	138	324	78
6/25	84	252	408	390	240	96	102	570	336	186	180	54
6/26	30	60	342	468	90	90	228	144	150	216	108	96
6/27	84	186	468	186	66	48	186	228	192	162	72	90
6/28	138	48	78	90	162	102	84	72	144	66	78	36
6/29	174	108	204	66	120	288	72	258	84	72	96	162
6/30	126	648	186	222	108	180	180	156	120	120	150	384

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Appendix A4.–Page 3 of 4.

Date	Hour											
	0000	0100	0200	0300	0400	0500	0600	0700	0800	0900	1000	1100
7/1	150	132	72	90	18	12	66	234	174	108	18	102
7/2	0	72	48	42	0	36	60	48	24	318	126	54
7/3	114	6	24	66	90	48	-12	48	60	60	6	-18
7/4	72	6	48	36	24	12	12	0	48	12	102	60
7/5	204	78	168	18	24	66	228	54	96	96	30	78
7/6	84	60	60	84	24	54	348	60	66	24	48	156
7/7	168	312	155	155	155	155	155	240	24	42	36	204
7/8	72	18	30	42	36	54	66	54	42	72	72	108
7/9	108	96	54	66	30	60	96	102	96	300	66	90
7/10	114	42	30	72	6	0	24	6	42	42	54	36
7/11	42	102	18	48	48	54	6	18	66	162	90	240
7/12	84	36	72	0	6	6	36	54	174	258	282	384
7/13	0	42	36	12	24	6	66	66	90	126	66	6
7/14	6	0	24	36	30	0	-12	66	6	48	198	162
7/15	36	72	66	102	78	144	72	138	24	60	42	54
7/16	36	6	66	0	24	30	18	60	60	150	12	36
7/17	24	0	24	12	42	42	54	144	378	162	60	18
7/18	-18	90	84	120	18	0	12	18	228	252	108	258

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Date	Hour											
	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300
7/1	36	180	378	168	300	240	108	210	120	162	96	42
7/2	78	72	84	258	66	150	168	102	78	30	66	78
7/3	54	66	78	138	72	84	36	30	144	78	24	18
7/4	252	426	318	48	162	204	150	348	186	432	84	84
7/5	102	156	330	234	192	180	432	204	456	360	114	222
7/6	144	222	144	138	228	264	348	162	156	192	30	204
7/7	246	108	138	78	264	252	222	360	150	120	132	36
7/8	234	102	276	300	162	180	108	234	210	264	372	144
7/9	102	222	258	156	426	330	216	120	156	378	132	144
7/10	72	90	108	276	198	330	408	270	318	180	18	90
7/11	96	30	72	312	48	216	132	54	30	60	12	60
7/12	6	114	240	72	264	474	186	36	60	102	84	72
7/13	318	18	36	258	54	18	30	12	12	36	42	24
7/14	168	138	102	228	18	102	198	30	96	36	180	174
7/15	30	162	18	162	48	30	156	60	192	90	30	144
7/16	168	138	48	78	138	120	18	150	42	30	60	258
7/17	210	156	108	90	18	108	60	78	156	24	42	36
7/18	234	0	0	0	0	0	0	0	0	0	0	0

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APPENDIX B: CLIMATE OBSERVATIONS

Appendix B1.—Climatological observations for the Nushagak River, 2009.

Date	Cloud Cover ^a		Precipitation (mm)	Wind Direction & Velocity (k/hr)		Air Temperature (°C)		Water Temperature (°C)		Water Color
	800	2000		800	2000	800	2000	AM	PM	
6/08	3	—	0.00	—	SE10-15	—	10.0	10.4	9.7	Brown
6/09	5	1	0.00	CALM	VARIABLE	4.5	20.0	11.6	9.6	Brown
6/10	1	1	0.00	CALM	VARIABLE	7.0	28.0	12.4	10.2	Brown
6/11	2	1	0.00	VARIABLE	N10-15	8.0	20.0	12.3	11.1	Brown
6/12	4	4	0.00	CALM	N5-10	—	10.0	11.7	11.4	Brown
6/13	4	2	0.00	S10-15	SW20	—	14.0	11.3	10.5	Brown
6/14	3	1	0.00	S1-5	S1-5	7.0	15.0	11.2	10.3	Brown
6/15	4	3	0.00	CALM	CALM	9.5	20.0	11.2	10.3	Brown
6/16	1	3	0.14	CALM	S5	9.0	15.0	11.3	10.9	Brown
6/17	3	4	Trace	CALM	SW10	10.0	12.0	12.1	11.2	Brown
6/18	3	—	0.08	CALM	S15	12.0	19.0	12.5	11.8	Brown
6/19	3	2	0.00	S5-10	S25-30	10.0	12.0	11.6	11.3	Brown
6/20	4	4	0.31	S5-10	S5-10	8.0	10.0	11.1	10.5	Brown
6/21	4	—	0.35	CALM	S10-20	5.0	11.0	10.6	10.4	Brown
6/22	4	4	0.15	S10	S10-15	5.5	8.0	9.7	9.6	Light Brown
6/23	4	4	0.15	E10	—	7.5	—	10.1	9.3	Light Brown
6/24	4	3	0.21	CALM	S1-5	7.0	10.0	9.8	9.2	Light Brown
6/25	1	3	0.28	CALM	CALM	3.0	14.5	10.8	9.3	Light Brown
6/26	4	2	0.10	CALM	VARIABLE	2.0	15.0	11.2	10.1	Light Brown
6/27	5	1	0.50	CALM	VARIABLE	5.0	18.0	11.5	10.5	Light Brown
6/28	2	1	0.00	CALM	NE1-5	6.0	17.0	12.4	11.1	Light Brown
6/29	4	1	0.00	S5-10	CALM	8.5	20.0	14.2	11.7	Light Brown
6/30	5	1	0.00	CALM	CALM	5.0	19.0	15.6	13.7	Light Brown
7/01	1	1	0.00	CALM	CALM	10.0	25.0	16.1	13.8	Light Brown
7/02	1	1	0.00	CALM	SW10-15	10.0	20.0	16.8	14.9	Light Brown
7/03	1	4	0.04	VARIABLE	SW5-10	10.0	14.0	15.7	15.3	Light Brown
7/04	5	2	0.00	CALM	CALM	12.0	20.0	16.3	14.7	Light Brown
7/05	1	1	0.00	CALM	CALM	18.0	26.0	18.1	15.3	Light Brown
7/06	1	1	0.00	CALM	CALM	19.0	27.0	19.0	14.8	Light Brown
7/07	1	1	0.00	S5-10	SW10-20	17.5	20.0	18.6	16.9	Light Brown
7/08	3	1	0.00	SW10-15	S15	10.5	21.0	19.0	17.4	Light Brown
7/09	5	1	0.00	CALM	NW5	11.0	28.5	19.2	17.9	Light Brown
7/10	1	1	0.00	CALM	SW10	8.0	24.5	19.1	17.7	Light Brown
7/11	1	1	0.00	CALM	CALM	10.0	26.5	19.6	17.9	Light Brown
7/12	1	1	0.00	CALM	SW15-20	11.0	26.0	20.2	18.7	Clear
7/13	3	2	0.00	N5	S20	12.5	17.0	18.8	18.8	Clear
7/14	4	4	0.00	S10	S8	17.0	16.0	17.4	17.3	Clear
7/15	4	2	0.04	CALM	S7	12.0	16.0	16.7	16.4	Clear
7/16	2	2	0.00	CALM	S5	10.0	23.0	17.7	15.8	Clear
7/17	4	3	0.17	S10-15	SW5-10	10.0	12.0	15.7	16.2	Clear

^a Cloud cover: 1 = cloud cover is less than 1/10 of sky, 2 = cloud cover not more than 1/2 of sky, 3 = cloud cover is more than 1/2 of sky, 4 = clouds completely cover the sky, 5 = fog or thick haze.